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The Research Quarterly

of the American Association for Health, Physical Education, and Recreation

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CONTENTS

A Survey of Recent Research Findings in In- dustrial Recreation	Jackson M. Anderson	273
Purposes in Physical Education as Evaluated by Participants, Physical Education Su- pervisors, and Educational Administrators	Charles C. Cowell, Arthur S. Daniels, Harold E. Kenney	286
Games, Sports, Dancing, and Other Vigorous Recreational Activities and Their Func- tion in Samoan Culture	Helen L. Dunlap	298
A Study of Some Personality Traits of Differ- ent Physical Activity Groups	Lance Flanagan	312
Individual Differences in Oxygen Metabolism of Work at Two Speeds of Movement	Franklin M. Henry	324
An Improved Tape for Measuring the Chest Girth	Peter V. Karpovich	334
An Evaluation of the Educational Aspects of Boxing as a College Activity	Robert E. Keefer	337
Existing and Desired Physical Education Activities in 126 Illinois Secondary Schools	Clyde Knapp and Beulah Drom	345
Breath-Holding as a Measure of Physical Fitness	Henry J. Montoye	356
Choice Batting Reaction-Time	A. T. Slater-Hammel and R. L. Stumpner	377
The Harvard Step Test as a Measure of Endurance in Running	Dominick A. Taddonio and Peter V. Karpovich	381
Research Abstracts		385
Book Review		391
Report of Committee on Criteria for Evaluati for Publication in the Research Quarterly, A		392
Guide to Authors		

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A Survey of Recent Research Findings in Industrial Recreation

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Purdue University Lafayette, Indiana

THE purpose of this survey is to point out and compare recent research findings in industrial recreation. Information gathered in this study should prove valuable to those responsible for the organization and administration of employee recreation activities. It should also be of value to those responsible for setting up training courses for industrial recreation leadership. Finally, it should stimulate further study of the many problems in industrial recreation which have not been subject to intensive research.

The findings of the present study are summarized under logical headings describing the particular phases of industrial recreation to which these findings pertain.

History and Present Status

Griffin (7) made a recent study of the history and present status of industrial recreation. He found that as early as 1883, George Pullman, of the Pullman Company of Chicago, was outstanding as one of the pioneer promoters of plant athletics. In 1896, the Ludlow Manufacturing Association established the Ludlow Athletic and Recreation Association as a corporation under Massachusetts statutes.

The Carnegie Steel Corporation established the first company recreation center at Duquesne, Pennsylvania, in 1912, and by 1920, had provided five centers, 12 athletic fields, and 15 playgrounds, all well equipped. In 1920, the Goodyear Company, of Akron, Ohio, had a seven-story building used entirely for recreational purposes. Other companies reported to have made recreational provisions for their employees by this time included the Shelby Tube Company, the Hershey Chocolate Company, the Chicago Telephone Company, and the United States Steel Corporation.

The activities provided during this period included athletics, camping, gar-

dening, community music, and various noon-hour entertainments. Family activities were an important consideration.

Employee recreation received increased emphasis during World War I. With the nation engaged in an all-out war effort, industries were interested in utilizing every available means for increasing worker efficiency and productivity. Many companies which had given little attention to recreation activities prior to this time, inaugurated programs and employed full-time or part-time

leaders to direct these programs.

After surviving the short postwar depression period, during which many industries either dropped or sharply curtailed their employee recreation programs, industrial recreation grew rapidly. Since business organizations were enjoying a boom period, employers were willing to spend large sums of money each year for welfare activities. By 1928, employee recreation had become an important part of the personnel relations program in a large number of companies.

With the onset of the depression in 1929, industries were forced to operate at the barest minimum. In many instances, the plant recreation programs were suspended. Most of the programs which survived were greatly curtailed.

Lack of funds forced many people to participate in the less-expensive types of community recreation activities. In spite of the lack of facilities and qualified leadership, this introduction to the less-expensive, yet pleasurable forms of activity, gave great impetus to community recreation during the depression years. The Federal aid which was introduced to help community recreation programs during this period increased the strength of the recreation movement.

World War II brought full-scale employment and business prosperity. The nation once again was engaged in an all-out productive effort to meet the demands of war. Employee recration programs were rapidly expanded in an attempt to achieve maximum worker efficiency. Many programs that had been discontinued during the lean depression years were reorganized on a

large scale.

Haniford (8), in a study of employee recreation in 472 companies, found that the greatest increase in the number of industrial recreation programs for men and women since 1900, occurred during the ten-year period, 1936–1945. He noted that there was an estimated increase of 16 percent during the period, 1940–1945, in the number of firms having an employee recreation program.

Griffin (7) points out the fact that industrial recreation has continued to expand since the end of World War II. He also indicates that this development has been accompanied by a stronger effort on the part of industries, municipalities, and other recreational agencies toward more satisfactory co-operation and co-ordination of programs and facilities.

Union-Sponsored Recreation

Ruth March (10) made an intensive study of the International Recreation Department of the United Automobile Workers—CIO, and a comparative study of the recreation program in fifteen local automobile unions. She reported that the International Recreation Department was established in 1937. One of the primary objectives of this Department is to provide recreation for all UAW members and their families without racial discrimination.

The Recreation Department is headed by a full-time, professional director, and the staff includes an assistant director and several part-time workers. In general, the Department's work consists of suggesting program activities and methods of organization on the local and regional level. The Department also serves in co-ordinating the various programs, and in training recreation leaders.

The lack of paid leadership and funds for travel in the International Department has resulted in a very uneven distribution of program activities in the 1,100 local unions and in the 16 regions. Regional recreation councils have been established in Cleveland, Ohio; in Jackson, Michigan; in Detroit; and, more recently, one in Pontiac, Michigan, and one in Western Ontario which co-ordinates recreation activities for three UAW local unions located within 50 miles of each other. The most extensive recreation program in the UAW-CIO is found in the Detroit area which benefits greatly from having the International office near-at-hand.

In the UAW, all dues are collected by the local union. Each member pays \$1.50 per month. The International constitution requires a deduction from local dues of $2\frac{1}{2}$ cents per month per member for support of the Education and Recreation Departments of the International offices. The constitution suggests that a similar amount be set aside for local educational and recreational programs. Of the $2\frac{1}{2}$ cents deducted for support of the International offices, the International Executive Board has allowed two cents for education and one-half cent for recreation. Thus the International Recreation Department receives about \$50,000 per year from dues paid by UAW members. Part of this money is returned to those regions showing an active recreation program.

It is the UAW policy to include in the program many recreation activities which are either money-making, self-supporting, or partially self-supporting. Entry fees for tournaments and leagues, as well as fees for self-sustaining classes, contribute to the budget. Expenditures of the International Recreation Department are largely for office maintenance and staff salaries. The monthly Roundup and other publications cost from 5 to 8 percent of the annual budget. A substantial sum is allocated to pay instructors and officials necessary to carry

on the recreation activities in the Detroit-area program.

The International office considers the local recreation chairman as the core of the program. With the exception of paid recreation leaders in Local 600 at Dearborn, Michigan, and Local 12 in Toledo, Ohio, all local chairmen are volunteer workers in the recreation program. Their recreation duties are performed outside of regular working hours of their eight-hour shifts in the factory. New chairmen are appointed or elected to their responsibilities early in the calendar year.

The International, Department advises local recreation chairmen to extend participation to a large percentage of the membership in a few activities, rather than extend the program laterally in a great variety of activities that become difficult for a volunteer to supervise. Participation rather than spectator activity is stressed. There is an effort to encourage fun rather than play with

keen competition for awards. The rank-and-file union members have not accepted play without awards and in many situations still demand loving cups, sweaters, and other prizes.

Local recreation chairmen are also encouraged by the International office to interpret the program to the Executive Board and to the local membership in order to get an increase in the deduction from local dues for recreation activities. Locals are advised to budget carefully and guard against overspending in the hope that the Executive Board will cover the deficit. The International Department hopes that many local unions will secure concessions that operate within the plants, and use the proceeds from the sale of candy, tobacco, and soft drinks for the extension of the recreation program.

Local unions are encouraged to utilize public facilities where possible, and as a last resort, to use private facilities for which rent must be paid. Realizing that the use of another agency's facilities means that a public relations job must be accomplished first, UAW recreation leaders are trained specifically for this job. Local chairmen are urged to make full use of the local union hall as a recreation center. The "lighted union hall" has become a common slogan for extending the use of local facilities and to help interpret the work of the recreation committee to the total membership of the union.

One of the stated functions of the International Recreation Department is that of working as a social force in the field of recreation. Perhaps the most time-consuming and costly program of the Department in the last few years has been the social action program in fighting discrimination in bowling. The Recreation Department has worked very closely with the UAW-CIO Fair Employment Practices Department on this bowling program. Representatives of the UAW Executive Board appeared before the Executive Board of the American Bowling Congress in Los Angeles in 1947, protesting the discriminatory policy of the ABC. These representatives stated emphatically that unless the ABC established a policy of fair play, regardless of race or creed, all UAW-sponsored bowling would be discontinued in ABC league and tournament competition.

When the ABC decided to retain its "Caucasian clause," the UAW spent \$12,000 to finance the UAW Bowling Association. Local unions were urged to break with the ABC, and three temporary field representatives were added to the staff of the UAW Recreation Department specifically to help locals organize unsanctioned teams and to find alleys on which they could bowl.

Values of Industrial Recreation

Erwee (5) studied the relation of industrial recreation to certain evidences of personnel morale. He determined the relationship between ten active industrial recreation activities and employee morale as reflected in employee ratings, job tenure, absenteeism, and safety. His research was conducted at Servel, Incorporated, of Evansville, Indiana.

Erwee obtained from the files of the plant recreation director, lists of names of participants in the various employee recreation activities. From these lists,

he selected the names of 96 participants in basketball, golf, tennis, table tennis, fishing, hunting and shooting, softball, bowling, pocket billiards, and gardening. He felt that if recreation has an effect on any of the evidences of employee morale, then those employees who showed a most active participation in one or more activities would have had the best chance to experience these effects. All employees had been in the service of the company for at least one year.

In conjunction with the Personnel Office, the 96 employees were identified with regard to factory number, department, job, age, job tenure, rating, and records of safety and absenteeism. This group of 96 participants was then matched with a similar number of non-participants in respect to the following factors: sex (only men were selected), age, job, and as nearly as possible, job tenure. Data pertaining to absenteeism, safety, and ratings were obtained for the non-participant group in the same manner as for the participant group.

It must be pointed out that the non-participant group does not necessarily imply that this group did not participate in any of the recreational activities provided by the plant. It is highly probable that many of them did take part

in one or more of the "less active" activities.

Erwee used recognized statistical procedures to test the differences between the participant and non-participant groups. The statistical tools employed in this investigation were the mean, the standard deviation, the standard error, and the "t" ratio. For purposes of comparison, the group-comparison and paired-pair comparison techniques were utilized.

Erwee found a significant difference between the average employee ratings of the participant and non-participant groups, in favor of the participants. Therefore, he concluded that there was a positive relationship between active recreation participation and employee desirability, as reflected by the em-

ployee's rating card.

In comparing the safety records of the two groups, the participant group was found to have one lost-time accident. This was not a serious accident as rated by the International Association of Industrial Accident Boards and Commissions standard scale for evaluating various types of disabilities. The total number of hours lost in the participant group was 300. The non-participant group had three lost-time accidents, one of which was serious. The total number of hours lost for this group was 1,864. Although the non-participant group showed a much higher number of hours lost due to accidents, Erwee did not find a significant relationship between recreation participation and safety.

A paired-pair comparison of the two groups was made to determine the relationship between recreation participation and absenteeism. The results indicated no significant difference in the two averages. Therefore, the study revealed no definite relationship between recreation and absenteeism.

Erwee was also unable to establish a significant relationship between recreation participation and job tenure. Since the two groups were matched for age, sex, job, and job tenure, there was expected to be no significant difference in the job-tenure averages of the two groups.

In a second study, Brown (2) attempted to determine the relationships of employee recreation to industrial safety. The study was conducted at a large midwestern plant.

Brown studied the personnel records of 79 employees selected at random from those who had a record of one or more lost-time accidents occurring within the period covered by the study, January 1, 1946 to December 31, 1947. The selected group had records of accidents responsible for from one to 600 days lost time. The random selection covered all 15 departments in the company in order that the hazard difference in the various departments would

not be a significant factor in the study.

The medical records of each of the 79 men were carefully examined. From the records, the following variables were checked: age; number of lost-time accidents; any physical defects at time of hiring; and number of times the employee had applied for first-aid treatment. From the personnel records of the selected group, the investigator obtained a record of the various tests which had been given each employee during the period of his employment. By studying the results of these tests, it was possible to check the variables concerning education and emotional factors. Information concerning the amount of training received by employees was obtained from the Training Department of the company.

On the basis of the extent of his participation in recreation activities, each employee selected for study was classified as very active, moderately active, or seldom active. In comparing these three groups, Brown found no significant difference in their safety records. Therefore, he concluded that there was no significant relationship between employee recreation and industrial safety in the company studied. It must be pointed out, however, that the recreation attendance records kept by this particular company were so inadequate that

the accuracy of Brown's findings is highly questionable.

One significant finding reported by Brown was the fact that the group of workers with the highest accident rate per man was composed of men who spent a considerable amount of time drinking. He also noted that some of the employees reported to work immediately after the drinking sessions which were a part of the group meetings.

An important study of the social phases of industrial recreation was made by Shaw (11). He pointed out the way in which these social phases have affected

employee-employer relations in the Los Angeles metropolitan area.

The National Industrial Conference Board (4) made a recent study of the administration and cost of employee recreation activities in 264 plants and offices. A large majority of the recreation programs studied in this survey were administered and supported by the employees themselves. In such voluntary programs, it is reasonable to assume that participation is indicative of value.

Sixty of the 264 companies reporting were reluctant or unable to give even an estimate of total participation. In the remainder, employee participation in recreation activities was estimated at from 1 to 100 percent. More than one-fifth of the companies reported 80 percent participation or higher. The wide appeal of recreation programs, as presently administered, is shown by

the fact that more than 45 percent of the companies included in the survey reported that 50 percent or more of their employees were taking part in the company programs. The findings indicated that as the company increases in size, it becomes more difficult to obtain a high degree of participation, even though the program is expanded in the larger organization to offer more activities to satisfy more interests.

Company executives were asked to indicate the values of their respective recreation programs. A tabulation of the replies revealed that the value stated most often was improvement in morale, phrased by some as "esprit de corps," and by others as "company spirit." Nearly 30 percent of the executives mentioned this intangible state or condition which seeks to express the net reaction of employees to all situations relating directly or indirectly to their jobs.

The value listed second in importance by company executives was the opportunity to become acquainted with greater numbers of fellow employees and to know them better. This value of the recreation program was stressed by a

fifth of the executives.

Fourteen percent of the executives felt that the recreation program enabled a closer association between fellow employees and between employees and management, and that this, in turn, brought about a spirit of comradeship. On the other hand, the understanding of one another's views and actions was listed as an important value by thirteen percent of the executives. It was felt that this understanding enabled employees to work as a team rather than as separate individuals.

It is interesting to note that many of the values cited by executives were advantages to employees as individuals. The opportunity to meet more people and make more friends has already been mentioned. Other personal benefits cited include improvement in health, reduction of fatigue, and relief from

boredom for the worker on a monotonous job.

Another personal advantage listed was the opportunity for employees to participate in recreation activities at low cost and with greater convenience. In some communities, no recreation activities are available outside of those provided by the company. In other communities, it is sometimes more convenient for the worker to participate in his company recreation program than to join in community activities. Due to the fact that the company helps to finance its recreation activities, the worker may be able to enjoy certain activities and facilities which would otherwise be too expensive for him to afford.

Executives listed certain benefits which the recreation program provides for management. These included the engendering of good will, a better attitude toward the company on the part of the employees, and increased interest and pride in the company. Another value of importance to management was stated in the fact that the recruitment of workers became easier because the company acquired through its recreation program the reputation of being a good place to work.

Several company executives felt that recreation activities offer a healthy outlet for pent-up emotion and energy. Other values mentioned include: aids

in retention of younger employees; helps assimilate new employees; reduces employee turnover and absenteeism. Values less frequently mentioned include the following: improves efficiency; increases production; serves as an advertising medium.

Those executives whose companies provided recreation activities for the employees' families emphasized the advantages of serving this larger group. These advantages included the availability of activities at nominal cost, the boon to health of body and mind, and the improvement in families' understanding of the company and their increased interest in it. Programs extending out into the entire community were believed to create community good will.

It is interesting to note that of all those evaluating their programs during this survey, only three executives felt that the value was indeterminable, and only two believed their programs had very little worth. One of the negative reactions was that of a department store executive whose firm had sharply curtailed its recreation program by dropping activities of very little appeal.

Leadership

Haniford (8) pointed out the widespread use of paid and volunteer recreation leadership. He found that 49 percent of the 265 companies included in his study employed either full-time or part-time recreation leaders. His findings indicated an increase of 18 percent in the number of full-time men directors and an increase of 6 percent in the number of full-time women directors since 1940. There was also a decided decrease in the number of part-time leaders reported. It was assumed that the decrease in part-time leadership was due to the fact that many part-time leaders had been replaced by full-time recreation directors.

Men without college training were found to be directing the recreation programs in 17 percent of the companies studied. This represented a decrease of 3 percent, since 1940, in the number of men directors without college training. This would indicate that many of those directors without college training had been replaced by college-trained men.

Twenty-seven percent of the recreation leaders were found to be trained in physical education or recreation. This represented an increase of 5 percent, since 1940, in the number of recreation leaders trained in physical education or recreation. There was a surprising decrease of 14 percent, since 1940, in the number of recreation leaders trained in personnel work.

Twenty percent of the companies reported the use of in-service training for men recreation leaders; 11 percent for women. The majority of the firms reported various types of in-service training rather than a single type. The most common courses offered in the in-service training program were listed in the following order: "How to Organize Activity"; "How to Interest Employees"; "Planning Exhibits and Demonstrations"; and "Teaching Techniques." These training courses were conducted primarily for volunteer leaders.

In order to determine the leadership caliber and effectiveness of the various recreation councils or associations, an attempt was made to find the number

of organizations having a paid co-ordinator or executive secretary. Twenty-seven percent of the companies reported a paid co-ordinator or executive secretary of such an organization; 41 percent reported no such paid leadership.

Fifty-one percent of the companies reported that their city had a yearround director of recreation; 8 percent reported their city as having a director for the summer months only. Nineteen percent of the firms had no director of

recreation for the city in which they were located.

Haniford concluded that there is a definite need today for increased leadership in industrial recreation. Councils or associations with paid executive leadership tend to: organize the athletic program on a more sound basis; develop the need for increased inter-departmental competition; and stimulate an interest in social and cultural recreation as well as athletic activities.

Weigle (14) conducted a study of the status and duties of 186 directors of recreation in industries known to have full-time recreation leadership. Of the 186 directors, 179 were men and 7 were women. The average age of these directors was 37 years. Only 9 of the directors were unmarried, while the remaining 177 were married. The average salary of 65 directors was found to be

in the range from \$4,000.00 to \$4,999.00.

The number of directors graduated from high school was 163; 94 had a college degree, and 12 held the master's degree. The most common college major was physical education, while the most common extracurricular activity was athletics. Seven directors indicated professional ball-playing experience. The two most common types of in-service training received by directors were public speaking and industrial relations. The two most common types of previous work experience of directors were community recreation and educational work. The types of training directors seemed to think most important were athletics and industrial relations. The three duties rated as most important by directors were, in order of importance, promoting activities, supervision of personnel, and teaching activities.

The two most common sizes of industries represented in the study were 1,000-1,999, and 500-999. The automobile industry was the most common industry represented. "Director of Recreation" was the most common title used in the companies studied. The director's salary was paid by management in the case of 176 of the 186 directors included in the study. The total number of paid personnel supervised by the 186 directors was 46. The most common

vocational status of the recreation director was that of foreman.

The number of directors indicating strong community relationships was 132. Of the 186 directors, 113 belonged to professional organizations. The three most common critical problems listed by directors were facilities and equip-

ment, time, and interest.

Twitchell (12) studied the relation of recreation leadership to other employee services in 353 business organizations. He found that the employee services, in addition to the recreation program, most frequently supervised by the recreation director were as follows: advice and counselling, employee publication, bulletin boards, community drives, trapsportation, travel bureau, and athletic

and recreation accident policy. He also found that industries throughout the United States do not generally offer extensive in-service training to equip personnel to accept the duties normally assigned to the recreation director.

The recent study of the National Industrial Conference Board (4), which covered practices in 264 companies, revealed that a fourth of these companies employed a full-time recreation director while another sixth had part-time directors. Thus in more than 40 percent of the companies, the programs were headed by an individual on the staff who was devoting either full or part time to employee recreation activities. The recreation director was found to be an "idea" man who introduced activities for groups that were neglected and suggested new sports and hobbies for those who were not attracted by the current program.

Administration and Cost

Acher (1) made a survey of modern practices in personnel services in 197 companies. He found that 92 percent of these firms provided recreation programs for their employees. These programs were most often administered by the personnel department of the company.

Gerber (6) reported a questionnaire survey of recreation practices in eighty companies. This study revealed that the amount of funds allocated by these companies for recreation per year per employee varied from 50 cents to 27 dollars.

Clark (3) interviewed personnel in 40 companies in an effort to obtain information on methods of financing industrial recreation. His findings revealed that revenue for financing the recreation program was obtained from the sale of milk, soft drinks, candy, cigarettes, and food. These commodities were found to be dispensed by the use of vending machines, cafeterias, and company stores. Firms with fewer than 300 employees were found to have difficulty in profiting from the use of vending machines because the volume of sales was small and did not justify installation of the machines. Companies with more than 500 employees were found to derive considerable revenue through the use of vending machines.

Sixteen recreation activities were found to provide revenue for the employee recreation program. This income was derived from attendance fees, or charges for use of the facilities accommodating these activities. Only one company in the employee group, 101 to 500, was found to use recreation activities to obtain income for the recreation program. Nineteen of the 40 firms studied were found to obtain revenue from recreation activities.

The total expenditure for recreation activities in the companies studied was found to increase as the number of employees increased. However, it was found that the expenditure per employee tended to decrease as the number of employees increased. In the fourteen companies charging employee dues for participation in the recreation program, the average amount collected per year per employee was \$2.75.

Warrick (13) studied 21 YMCA industrial recreation councils in an effort to determine the best methods used in organizing and administering these

councils. One of the results of this survey was the finding of annual costs for the use of proper facilities in conducting the council programs. These costs ranged from \$250 to \$4,500 per year. Some councils were found to be using only YMCA facilities at a minimum cost. Other councils found that their expanded program demanded the use of additional community-owned or

privately owned facilities.

Kraft (9) made an intensive study of the administration of industrial recreation in five major automobile companies in the Detroit area. He reported that the companies studied were using tax-supported recreation facilities too extensively due to the fact that their own facilities were inadequate. He also found that all types of activities were not given equal emphasis in the recreation program in these industries. Some companies over-emphasized athletic activities and curtailed some of the other important activities. A significant finding was the fact that record-keeping practices of the companies were, on the whole, not too good.

The National Industrial Conference Board survey (4) of the administration and cost of employee recreation activities in 264 companies revealed that central employee associations administer approximately 46 percent of the recreation programs surveyed. Employee association administration was found to be the most popular method of conducting recreation activities. Of the total group of employee recreation organizations, approximately half were called

clubs and half, associations.

A little more than one-fourth of the employee associations were found to be incorporated. The survey points out that if the employee association owns valuable property such as clubhouses and other facilities, or if it holds investments, incorporation under the laws of the resident state is essential. Such incorporation gives the organization the right to accept property, real and personal, and to manage, invest, and dispose of it according to the objectives as set forth in the organization's constitution and by-laws.

In more than a fourth of the employee associations studied, membership was automatic, without dues. Activities of these clubs were financed through other means, such as vending machine receipts, playing or admission fees, or company contributions. In nearly seventy-three percent of the associations,

however, dues were paid by the members.

In some cases the dues were nominal—less than one dollar per year. The membership fee most frequently charged was one dollar. More than a third of the associations were found to charge this amount. When a nominal fee was charged for association membership, additional dues were frequently charged for membership in specific activity groups. In such instances, belonging to the central association conferred the privileges of voting and the right to hold office, and made the worker eligible for membership in any of the various activity groups. In many instances, the association membership also covered admission to certain special events planned for all members.

More than 65 percent of the employee associations included in the survey were governed by boards of directors, governors, or trustees. The methods of choosing directors were many and varied. In some associations they were

elected at large; in others they were elected by divisions or departments of the company. It was found that when the activity-plan of organization was followed, a director was usually selected from each activity group.

Some association constitutions were found to provide for a proportionate number of men and women on the board of directors, based on the total number of men and women employees in the company. Some clubs insured a fair representation of both office and factory workers on the board. In the smaller companies, directors were often chosen by the club members in an open election or secret ballot without formal nominations. However, most of the larger associations provided in their constitutions for a system of nomination prior to the election. In a fourth of the 90 companies in which governing boards controlled the affairs of the employee recreation association, at least one of the directors was appointed by management.

Executives in the companies surveyed were asked to provide a figure for the approximate total expenditure for recreation activities per employee. The amounts ranged from a minimum of fifty cents to a maximum of \$275 per year. The expenditures reported were exclusive of overhead and investment in permanent facilities, but were supposed to cover all other items, including salaries. As Clark (3) had revealed in an earlier study, the cost per employee was found to decrease as total employment in the company increased.

Since extreme cases greatly affected the average figure for expenditures, the median cost was more indicative of general company practice. The median total expenditure per year per employee for the entire group of 155 companies reporting was \$5.

Conclusions

The findings reported in the present survey have indicated certain trends in the field of industrial recreation. One of the most encouraging trends is the employment of more full-time directors to organize and administer the employee recreation program. The decided increase in the number of companies sponsoring employee recreation is another important trend.

The fact that an increasing number of industrial recreation directors were found to be college trained would indicate a trend toward hiring more highly qualified leaders to direct the program. It is also evident that employees are enjoying a larger and larger share of the control of company recreation programs. Another definite tendency is seen in the increase in the number of companies using public recreation facilities. This would indicate increasing community—company co-operation.

Perhaps the greatest weakness revealed in the administration of industrial recreation is the widespread lack of adequate records concerning the various company programs. The absence of these records makes further research in many areas of program administration difficult if not impossible. The establishment of good record-keeping practices will make possible valid research studies covering the many problems of administration which have not been investigated.

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Purposes in Physical Education as Evaluated by Participants, Physical Education Supervisors, and Educational Administrators

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ON THE occasion of the annual meeting of the Western Conference Physical Education Group in Chicago on December 10, 1949, one of the topics for discussion was, "Are the Service Courses in Physical Education Fulfilling Their Purposes?" The discussion by the group, of the basic purposes of the required program soon revealed great differences of opinion and little common agreement as to the educational, biological and sociological functions of physical education for college and university men in their freshmen year.

As a result of this apparent disagreement, the committee authoring this study was appointed and directed to return in December 1950 with a statement setting forth its best conception of the general and specific purposes which should underlie the physical education service program for men in our universities.

Obviously, certain classified, generalized and interpreted data were sought by the committee for the purposes of guidance of practice in the administration and teaching of college and university physical-education for men.

The Problem

The problem of this study was to determine the general and specific purposes which should underlie the service programs in physical education for men in our American colleges and universities.

Answers were sought to the following questions:

1. What are the chief values and purposes which male university freshmen seek to achieve by means of their required physical education programs, i.e. what worths or values do they seek to get out of their experiences? 2. In the judgment of university Directors of Service Programs in Physical Education for Men, to what extent should they definitely plan to satisfy those purposes in physical education which the students consider important to them and to what extent are they in agreement with the purposes expressed by their students?

3. To what extent do presidents, as administrators of colleges and universities comparable

to the Western Conference institutions, agree with their respective physical education service program directors as to the purposes of physical education for men and to what extent are they in rapport with the purposes which students are trying to achieve?

Method

The descriptive method of the survey type involving the analysis and interpretation of the present status of the purposes of university service programs in physical education for men was the method employed.

TECHNIQUE

The technique, or instrument employed (See Appendix A) was a combination check-list-attitude scale. The choice of the items on this scale was derived from careful analyses of similar attempts by Lapp (3), Cowell (1), McGonigle (4), and Verrill (8) to ascertain the goals of achievement of high school boys and girls in the physical education situation.

Studies related to the "needs" and problems of adolescents such as those by Doane (2), Shimberg (6), Mooney (5), and numerous others verify that these purposes are highly related to goal satisfactions which influence the

direction of the behavior of adolescents.

It was therefore assumed that these were dominant purposes which adolescent youth found to be strongly motivational, i.e., few of these purposes were expected to be strongly rejected as personally inapplicable to the students involved. Respondents were encouraged to add any other purposes they wished to add. All responses were anonymous and given under favorable conditions. Students were told that efforts were being made to improve their physicaleducation programs and that it would be of considerable value to know what students really "want to get out of their physical education experiences".

STUDENT RESPONDENTS

Approximately 175 freshmen students in required physical education from each of the following institutions were asked to use the check-list-attitude scale: University of Illinois, The Ohio State University, Purdue University. A total of 500 cases was used in order to facilitate statistical handling. No student majoring in physical education was included. All professional schools in the three representative universities such as liberal arts and science, fine arts, commerce, engineering, agriculture, education, pharmacy, and similar schools were well represented. War veterans represented less than one percent of the group. The average age for the students was 18 years 6 months when the responses were made.

RESPONDENTS REPRESENTING SUPERVISORS OR DIRECTORS OF SERVICE COURSES

Some 55 college and university supervisors or directors of service programs of physical education for men responded to the check-list-attitude scale. They were asked, "How strongly do you, as an educator, agree or disagree that we, in our college freshmen physical-education programs, should definitely plan to satisfy the purposes listed?" Opportunity was given to add any additional purposes to the list.

RESPONDENTS REPRESENTING UNIVERSITY OR COLLEGE PRESIDENTS

Check-list-attitude scales were sent to the presidents of fifty large institutions rather comparable in size to the Western Conference type. Forty-four replies were returned. They were asked, "To what extent do you agree that your physical education department should assume the student purposes listed below for college freshmen and set up learning experiences for students in physical education so that these purposes might be achieved?" Again, opportunity was given to add any additional purposes to the list.

CLASSIFICATION OF PURPOSES

No effort was made to classify purposes under headings until all data were analyzed and no great importance should be attached to the classifications appearing on Charts I, II, and III. It was felt that some classification, however crude, would be helpful to the reader. The heading "Ego Integrative" deals with the assumption that each individual lives in himself and with himself and must develop a sense of worthy self-hood, must believe in himself and have a sense of significance as an effective member of the culture in which he lives.

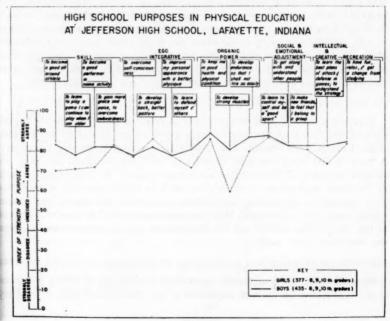


Chart I

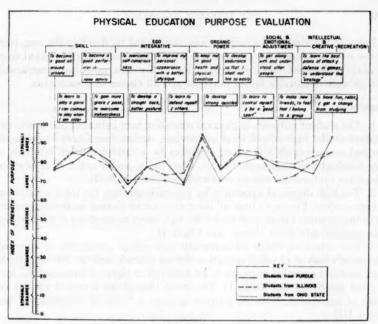


Chart II

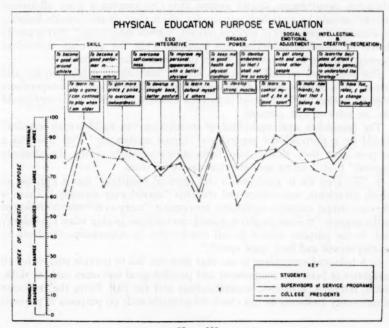


Chart III

Index of the strength of purpose was determined by dividing the sum total of the weighted scores for any purpose by the maximum total weighted score if *every* respondent had "strongly agreed." By this procedure comparable indices were obtainable for all purposes and all classes of respondents.

Results

1. The student purposes in physical education here indicated and previously verified at the high school level in previous studies (see Chart I) are again verified as acceptable and strong purposes by a careful random sampling of five hundred freshmen from Illinois, Ohio State, and Purdue after physical education professional majors were excluded (see Chart II).

2. The high degree of agreement by the students from the three institutions is very evident. Freshmen from all three universities showed marked agreement as to the personal values they would like to achieve as members of their respec-

tive physical-education classes (see Chart II).

3. The extent to which 44 university and college presidents, 55 directors and supervisors of physical-education service courses, and the 500 male freshmen students agree on purposes to be achieved in physical education for men is most gratifying (see Table 1). The trend throughout is one of various degrees of agreement. With no purpose is there a trend of disagreement (see Chart III).

4. The presidents seemed undecided as to whether or not their physical education departments should assume that "to become a good all-around athlete" should be a student purpose for which they should provide learning experiences. Supervisors of services courses "agreed moderately" that students should be aided in achieving this purpose, while the students themselves "agreed" that it was a purpose which they would like to achieve.

The presidents seemed undecided about "learning to defend myself and others" as a purpose which their departments should accept. The supervisors "agreed moderately" to accept it and the students "agreed" that they would

like to achieve this purpose.

The presidents were undecided as to whether "to build strong muscles" should be a purpose, the supervisors "agreed moderately" that this was a purpose that they should help their students satisfy, while the students

"agreed" that it was a goal of achievement for them.

5. "To keep me in good health and physical condition" was a purpose on which presidents, supervisors and students "agreed very strongly." There is likewise strong common agreement concerning "carry-over" sports indicated in the purpose "to learn to play a game I can continue to play when I am older" and, in the purpose related to self control and sportsmanship, "to learn to control myself and be a 'good sport'."

6. A balanced curriculum is one that does not fail to provide stimuli for all categories of behavior components and psychological outcomes such as skills, ideals, interests, attitudes, understandings and the like. From the responses of university freshmen to this check-list-attitude scale on purposes in physical

TABLE 1
Degree of Agreement on Purposes by the Three Types of Respondents

Purpose	Purpose University & College Presidents		Freshmen University Students in Service Programs of Physical Education for Men	
1. To become a good all-around athlete.	Undecided	Agree Moderately	Agree	
To learn to play a game I can continue to play when I am older.	Agree Very Strongly			
3. To become a good performer in (name activity).	Agree Moderately	Agree Very Strongly	Agree Strongly	
4. To gain more grace and poise, to overcome awkwardness.	Agree Strongly	Agree Strongly	Agree	
5. To overcome self-consciousness.	Agree	Agree Strongly	Agree Moderately	
6. To develop a straight back, better posture.	Agree	Agree	Agree	
7. To improve my personal appearance with a better physique.	Agree	Agree Strongly	Agree	
8. To learn to defend myself and others.	Undecided	Agree Moderately	Agree	
9. To keep me in good health and physical condition.	Agree Very Strongly	Agree Very Strongly	Agree Very Strongly	
10. To develop strong muscles.	Undecided	Agree Moderately	Agree	
11. To develop endurance so that I shall not tire easily.	Agree	Agree	Agree Strongly	
12. To learn to control myself and be a "good sport".	Agree Very Strongly	Agree Strongly	Agree Strongly	
13. To get along with and understand other people.	Agree Strongly	Agree Very Strongly	Agree	
14. To make new friends, to feel that I belong to a group.	Agree	Agree Very Strongly	Agree	
15. To learn the best plans of attack and defense in games; to under- stand the "strategy".	Agree	Agree	Agree Strongly	
16. To have fun, relax and get a change from studying.	Agree Strongly	Agree Strongly	Agree Strongly	

education, it is evident that none may be skimped or eliminated without peril to the maximum contribution which physical education can make to the education of college or university students.

7. Less than one-half of one percent of all the respondents added purposes not originally on the list. Careful analysis of these found practically all of them of such a nature that they were contained in purposes already on the list

Possible Implications of the Findings

IMPLICATIONS FOR EDUCATIONAL PHILOSOPHY

1. The chief function of education is to develop the potentialities of the individual to solve life's problems satisfactorily; to help people grow, meet a need and keep out of trouble. It is obvious that university freshmen expect their physical-education experiences to help them make adjustments.

2. Learning is bound up with the total personality of the learner. It is greatly influenced by the learner's values. These motivate behavior; make it purpose-

3. Human beings are indivisible. In every school task, intellectual, emotional, and volitional processes play a part. The motor, social, emotional and intellectual development of young people are highly interrelated; one aspect of development has its influence upon other aspects.

4. Education should be, among other things, a great adaptive mechanism and its success should be measured by the assistance it renders in the process of adaptation and not merely by acquisition of subject matter. We should be as concerned about what the subject matter does to the student as what the student does to the subject matter.

5. Education is a dynamic process, going on in response to inner needs and by means of self activity. All organisms have needs and meet their needs by methods of adjustment. This biological conception of education is basic. Play and physical education are important avenues of need satisfaction. Biological, social and emotional needs are met.

6. What we see operating in university freshmen in physical education are evidences of the processes of adjustment—efforts to meet certain needs, to satisfy certain purposes. Our function as teachers is to facilitate these adjustments by proper conditions, i.e. space, time allotment, experiences and equipment as well as friendly guidance.

7. Conscious purpose, a goal, is basic to learning. Too often we stress abilities without considering purposes. Purposes tell us why students want ability and should therefore receive strong consideration. All learning is related to something.

8. At the male adolescent level in our culture, we know that satisfaction of such ego motives as the desire of recognition, prestige, status, and the like are dependent or contingent upon the acquisition of a good physique, game skills, physical courage and social poise. The adolescent male wants skill, physique, muscular strength because his feelings of adequacy, security, accept-

ance and similar need satisfactions are "contingent" upon skill, strength and similar factors. Purposes so closely related, in our culture, to the social and emotional security of adolescents are bound to be very important to them.

9. Education should be interested in the forces underlying motivation behavior if it is to be individually satisfying and socially effective. We must create, modify and extend purposes in our students and work through the purposes which have been developed within them.

IMPLICATIONS FOR MENTAL HEALTH

1. Human organisms strive for goals, have "minds of their own" and do not wait to respond mechanically to stimuli. They tend to use what is available in the environment to meet their needs. "Delinquent" environment tends to breed delinquent behavior. Adjustment or self-realization cannot be taught, except by providing materials, opportunities, conditions, experiences whereby, through self activity, the individual reaches the desired goal of achievement.

"If enough good food, rest, sunshine, and so forth, are obtainable, so that the physiological organism is strong and healthy, if there is sufficient opportunity for free activity, for strivings for ends which he considers desirable, and for the appreciation of things which are to him beautiful; and if in the eyes of his comrades, there is something of respect for him; and if there are those in whom he can confide and those whom he can in some way serve, man may experience that feeling of happiness which has been the goal of life for untold generations." (7)

This "inner equilibrium" or feeling of well being resulting from a satisfactory balance between man and his "personal world" is the natural goal of the organism. We see evidence of efforts to achieve these conditions in our physical-education classes.

2. Physical-education activities offer great opportunities for satisfaction of emotional needs. Emotional behavior arises primarily as a result of the blocking of behavior designed to satisfy either a dynamic need or a desire that contributes to the sense of personal worth or security of the individual. Excessive denial of one or more of these dynamic factors tends to disorganize emotional behavior or leads to gradual disintegration of mental health.

3. Learning is best promoted in *any* situation in proportion to the degree that the situation offers security, recognition, success, shared experience and where opportunity is provided for personal and social adjustment as exemplified by status, a feeling of belonging or social approval. We learn those things

which are necessary for adjustment.

The natural effort of organisms to support their integrity as autonomous personalities is seen in the extent to which five hundred university freshmen seek to satisfy their basic personality needs in the physical education situation.

4. In our culture, physical education and athletics for the male animal provide avenues for the satisfaction of basic personality needs in manners socially desirable and psychologically wholesome. It is imperative that competition be well balanced; that we do not throw sensitive, ill-prepared youth into situations to which it is impossible to adjust. Competition is part of life.

We are motivated by insecurity—we get busy and protect ourselves—but the value of insecurity for positive motivation depends on the proper dosage. Life is made up of success and failure and from each situation we learn something. We don't expect a boy to do a man's work. A carefully chosen and properly timed and appropriately increasing amount of insecurity can be a morale building process. When we bring children along in our physical-education programs from the kindergarten to the college level, we set their developmental tasks with these lessons in mind as we aim at the eventual development of a socially and emotionally mature adult citizen.

5. Observation on the playing field gives a clearer picture of the structure of the whole personality than do most other school situations. Perhaps a major function in physical education in a university should be our mental hygiene function—to give more attention to those temperamental and dynamic trends of the total personality which research indicates accounts for educational

achievement about as much as do purely intellectual abilities.

To the degree that students are freed from the conscious necessity of "protecting their egos", i.e. relieved of many of the feelings of insecurity which it is obvious they try to overcome on the playing fields, are they able to turn to "higher" motives of mastery and achievement in scholarship. When we speak of the relation of the "emotional climate" of the classroom to the learning of students in that classroom, this is exactly what we mean. Incidentally, several studies indicate that teachers who helped students most were those who set up situations in which students felt secure, developed a feeling of individual success and adequacy, felt that they were participants, not simply "reactors" and that they belonged. They learned more rapidly when the "emotional climate" was favorable. In situations where basic personality needs are satisfied, morale tends to be high.

IMPLICATIONS FOR GUIDANCE

1. Individual guidance must be based on an understanding of the student which the use of evaluating techniques brings to us.

2. We should share our knowledge with the student in mutual exploration of his needs and problems, help him define his problems, face them squarely and then do something about them. This applies especially to the extreme "deviates."

- 3. Since solutions frequently require bringing about changes in a situation more often than they require bringing about direct changes in the student, we must be conscious of group size, space, the dangers of throwing the unskilled into skilled groups, and numerous other factors affecting learning and adjustment.
- 4. We ought to use our wonderful opportunities to study the interaction of people in groups in addition to searching for known facts and principles that would explain observed behavior. In this purpose study we see some of these factors and their influence on the development of students. Sociometric research gives us some knowledge of the processes involved in social development. In games and sports, the processes of affiliation, identification, group action and interaction are important means of social development. A "socio-

gram" showing the structure of one of our physical education groups in terms of interpersonal relationships would give a visual representation of a constellation of attitudes toward each other that are expressed by individuals in the group. The student's journey through the physical education department can be made a planned and purposeful educational journey only if we go beyond "giving exercise" and use the rich guidance opportunities open to us.

IMPLICATIONS FOR CURRICULUM CONSTRUCTION

1. There is a growing general tendency to think of the curriculum as consisting of all the planned experiences the learner has under the direction of the school. This definition makes the term "extracurricular activities" applied to intramural or interscholastic athletics a redundant term.

2. The fact that curriculum emphasis now focuses attention upon the kind of experiences the learner should have rather than upon the "subjects" he should study requires some reorientation of our thinking toward our physical education curriculum. This purpose study indicates the need of experiences and consideration of how these learning experiences are organized (method) in terms of meeting the psychological needs of students.

3. "Experiences" are over-all processes by which students make attempted adjustments to solve a problem, meet a need or get out of trouble. Physical education should provide experiences which aid this process of adjustment.

4. Motivation is central in the curriculum because it is in response to basic needs that man adapts and learns. The problem of implementing effectively the principle of gearing the curriculum to psychological needs is a major task. Physical education activities provide very important "goal resources" for need satisfaction, even in later adolescence.

5. Objectives refer to the combined goals of teacher and learner. These form the bases for selecting experiences. From the point of view of this study there is some indication that learning experiences should be organized around persistent life situations which students encounter and that the overall organization of the physical education curriculum should center around the personal-social problems of youth. One example of heeding the latter would be more conscious attention and planning of coeducational experiences in physical education.

6. A curriculum in which the educational objectives of parents, teachers, and administrators become the conscious purposes of the students would be an educational Utopia in which permanence of learning would be at a maximum. Our data do not include parents but the high degree of agreement in this study concerning purposes in physical education for male university freshmen by the administrators, teachers and the students themselves perhaps accounts for the fact that our experiences on the track and field and in the pool and gymnasium have given tone and color to our lives long after our school days were o'er.

7. Lastly, there is a great need for attempts at evaluating the influence of the outcomes of experience. We have seen, to some extent, what university freshmen want to get out of their physical-education experiences. What do

they get out of them under varying curriculum approaches?

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APPENDIX A

Age in	Years	Months	School	Veteran		Non-Veteran	
		or	Department		_		-

PHYSICAL EDUCATION PURPOSE EVALUATION

Below are listed some possible values students want to get out of their physical education experiences in class.
 To what extent do YOU agree or disagree that these are personal values which YOU would like to achieve as a member of a physical-education class? Make one check in the appropriate column. Please check every item in some one column.
 Do not sign your name.

	Strongly Agree (1)	Agree (2)	Undecided (3)	Disagree (4)	Strongly Disagree (5)
To keep me in good health and physical condition.	interest				
2. To learn the best plans of attack and defense in games; to under- stand the "strategy".					
3. To develop strong muscles.		1			
4. To learn to play a game I can continue to play when I am older.					
5. To improve my personal appearance with a better physique.					
6. To have fun, relax and get a change from studying.	1		1 100		1-1-1 1-11-1
7. To develop endurance so that I shall not tire easily.		-	100 101		
8. To make new friends, to feel that I belong to a group.	, K				
9. To overcome self-consciousness.					
To get along with and under- stand other people.				AT THE	14.11
11. To gain more grace and poise, to overcome awkwardness.					
To learn to control myself and be a "good sport".					
 To develop a straight back, better posture. 				57 =/ T	
14. To become a good performer in (name activity).					h un
 To learn to defend myself and others. 				O Train	
16. To become a good all-around ath- lete.		e - No	7/13		
17. Add other purposes you think important.			1000		

Games, Sports, Dancing, and Other Vigorous Recreational Activities and Their Function in Samoan Culture

HELEN L. DUNLAP

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The original interest in making this study came from reading an article entitled: "Hidden Possibilities for Research in Physical Education and Recreation (24)."

Purpose of the Study

The article brought out the fact that the literature in the field of physical education and recreation is primarily concerned with the use of this "educational tool" in the countries of our "Western civilization." In contrast to this, it pointed out that the writings of anthropologists, ethnologists, and others contain an abundance of information on the amusements and play life of all people, everywhere; and suggested that a diligent investigation of these materials would provide a better understanding of the inter-relationships of physical education and recreation with other major aspects of living and a fuller picture of the contributions which they have made in enriching the daily living of the diverse peoples of the world.

The culture element of games, sports, and dancing has been classified by an eminent anthropologist as one of the "common denominators" of all human cultures (16). The task of investigation and analysis of the particular role of this culture element in the total culture of any given people remains to be done.

It is hoped that this study will be a contribution to such an understanding. The purpose of the study is two-fold: (1) to determine the manner in which games, sports, dancing and other vigorous recreational activities entered into the total culture of the Samoan people of the early 19th century; and (2) to discover the changes which were brought about in Samoan vigorous recreational activities through culture contact.

Two factors were primarily influential in the selection of the Samoans for investigation. First, they were in a relatively primitive and "untouched" state at the time contacts were made with the white man; and secondly, the explorers, missionaries and others, who made some of the contacts left a wealth of written material as a result of their first hand observations.

RELATED STUDIES

Since 1947, when the possibility for this type of historical research in physical education was pointed out, two parts of one such investigation have been

published. The study which is in progress is entitled: "Some Aspects of the Role of Games, Sports, and Recreational Activities in the Culture of Modern Primitive Peoples (25)."

The purposes of the total investigation are:

(1) to show that sports, games, and recreational activities form a universal and fundamental element of human culture; and

(2) to illustrate how immensely more complex than is often supposed are the forces that produce the activities commonly described as recreational (25, p. 198).

Method of Procedure

As the data for this study were collected from the literature on Samoa, a critical review was made of this material. Answers were sought for the following questions: what games, sports, dances and other vigorous recreational activities were engaged in by these people when they were first discovered by European explorers; how did this phase of living fit into their total culture, i.e., how was it integrated with the other major aspects of living, such as religion, government and education; and what effect did the cultural changes, brought about as a result of the discovery of the islands, by foreign powers, have on these activities?

In order to obtain as complete a picture as possible of the Samoan vigorous recreational activities, the physical recreation patterns of the islanders were traced from the early 19th century to the 1930's. In addition, such major aspects of their early culture as their social, religious, economic, warfare and educational systems were carefully examined in order to form a basis for the understanding of the inter-relationships existing between them and the phase of culture being investigated.

Geographical Setting-1930, and Brief History of Early Samoa

The inhabitants of Samoa are members of the Polynesian Race. They live on 14 islands, with a total land area of some 1,700 square miles, located in the southwestern Pacific in the large ocean area of isolated island groups known as Polynesia.

The existence of these inhabited islands was not known to the so-called "Civilized World" until 1722 when they were briefly sighted by a Dutch explorer named Roggenween. After that event, several other exploring ships and whaling vessels made brief contacts with the islands. But, it was 1830 before anyone remained in Samoa long enough to gain an understanding of the Samoan way of life.

At that time, John Williams of the London Missionary Society established a Christian Mission there (28). That event provided for the settlement of several missionaries. It also provided an opening for the entrance of traders, planters and official representatives of foreign nations interested in the area.

Recreational Life Involving Vigorous Physical Activities—Early Nineteenth Century

In Samoa, during the early 19th century, a considerable amount of time was spent by individuals of all ages and ranks in a variety of games, sports and dances. These, they appeared to enjoy exceedingly (28). So much so, in fact, that one foreign observer was moved to report that:

Life has no engagement so important that the islander will not cancel it at once on the plea of sport (6, pp. 562-63).

Many of their activities took place in the ocean and along the shore. There the natives spent hours enjoying swimming (2), diving (15), canoeing (2), sailing (21), surf-riding (5), turtle riding (1), sliding (5), and fishing (26).

The activities played on land ranged from simply organized games to highly organized sports. They included such things as hide and seek (2), pulling or tug of war (21), racing (26), juggling (5), tobogganing (5), spear parrying (26), boxing (21), wrestling (21), kicking matches (21), club fighting (19), dart throwing for distance (5), pigeon hunting (20), and dancing (21).

Participants in these physical recreational activities ranged from a few members of one village playing in an informal manner to the mustered forces of villages or districts competing in a formal manner for a championship in one or more events.

Their sports meetings always started with a great deal of ceremony. There was presentation of food and gifts, drinking of kava, and the delivery of speeches by all parties, in which each extolled the greatness of their opponents and their own humbleness (6).

At such gatherings the traditional rules for all activities were strictly adhered to, as a serious breach was likely to be considered an insult to be wiped out by war. Each activity always had prescribed judges and other officials who were responsible for seeing that it was properly conducted.

Victory was highly regarded and was everywhere recorded in legend and song. Defeat was a stain which the vanquished hoped to remove later.

The Inter-relationship of Sports, Games, Dancing, and Other Recreational Activities with the Major Aspects of Samoan Culture—Early Nineteenth Century

Although neolithic in material culture, the early Samoans had a highly organized social order. They were a very ceremonious people, with practically every phase of their life regulated by elaborate codes of behavior.

SOCIAL ORGANIZATION

... social organization is the principal preoccupation in Samoa.... The Samoans regard the social structure, a hierarchy of titles carrying with them specific privileges, as of paramount importance (18, p. 481).

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This observation although made of the people of the 1920's was equally true of those living in 1830.

The Samoans spent a great deal of time visiting one another for religious, governmental, economical, ceremonial, and recreational purposes. At every one of their major meetings some vigorous physical activities were enjoyed.

Some meetings were especially planned to determine championships in certain games. In considering the benefits derived from participation in these activities one authority (5, pp. 573-74) reported the following:

The social value of the community games was important. The smaller competitions in the same village brought the young people and adults together and gave them some relaxation from the perpetual quest for food on land and sea. The competitions between different sections of a village or different villages brought together a larger group of people on terms of social intercourse. The local people had to provide food for the visitors, spectators as well as competitors, and the occasions were social events in which all feasted as the foundation of enjoyment. Singing and dancing added to the festive nature of such occasions.

In this atmosphere of friendly social intercourse group unity was welded Everyone had some role to play and in so doing felt himself a necessary part of the gathering. This element of unity was all important in Samoa in view of the fact that political power rested with the group which had the strength to overcome all others in warfare. Strength then as now was greatly dependent upon unity.

Competitive games also gave the people an outlet for the intense spirit of rivalry which they had. Families, villages, and districts were continually striving to gain prestige in all things deemed worthwhile, and victory in any

sport was a distinction coveted by all.

In these inter-community activities, prestige was sought for the village, not the individual (6); and all members of the winning group, whether or not they

actually played, gloried in the victory.

Certain activities, such as pigeon netting, bonito fishing, and some types of dancing, were reserved for those of high rank. Such events served to point out the importance of these individuals in Samoan society. The best was set aside for them.

A wide variety of games, sports, and dances played an important part in the ceremonies marking the life crises of birth, puberty, marriage, and death. Although not mentioned in any of the source material, it would seem that these diversions were partially influential in alleviating the emotions such crises aroused in the people. At death, for example, when they were filled with great sorrow and fear, they played all kinds of games. Perhaps, by participating in activities which caused some amusement at a time when life was otherwise mournful and solemn, the people were sooner able to adjust to the situation which had developed.

RELIGION

The gods of the Samoans were legion. To them the islanders ascribed human feelings and actions, and believed that they derived great enjoyment from human diversions.

When there were funerary festivals, first fruits rites, and on all such ceremonial occasions of the first order of importance, the gods concerned were not regarded as far off somewhere in the sky looking on, but were believed to be present with their worshippers, enjoying with them the exhilarating effects of the feasting, dancing, singing, and social emulation (11, p. 88).

Their deities were ever present and ever worshipped as it was from them that the natives thought that they and all of nature received power, or mana, to accomplish desired results. In addition to daily worship they were accorded special festivals. There were annual rites for propitiating the more important ones. At those events, club fights were engaged in by all participants until the blood flowed. The blood was an offering which was thought to cause the gods:

....to be all the more pleased with their devotedness, and answer prayer for health, good crops and success in battle (26, p. 57).

Dancing, especially of the erotic type, was also a part of these services. Handy (11, p. 210) wrote the following concerning the purpose it served:

The dancing at the religious festivals was closely related to the offerings and feasts in honor of the gods: they were believed to entertain the gods, and at the same time to rouse and stimulate them. Mana in one fundamental sense, meant procreative power. The erotic dancing of the tropical islands of Polynesia, which was at its origin a form of worship, was designed to stimulate and to bring into action the mana of the gods who were believed to be animated by the same emotions as men and on whose procreative activities the fecundity of human beings, the earth, and sea depended.

At all ceremonies for whatever purpose some part was devoted to worship. In considering the possible religious implications of their birth celebrations, one authority (11, pp. 220-21) reported:

Soon after a child's birth, the Samoans celebrated a great feast with games and dances. There was another such celebration when the child could sit up, and still others when the child could crawl, stand upright and walk. Although in Samoa these functions may have been mainly social, for here the social aspect rather than the religious always assumes the place of larger importance in festivities, there was undoubtedly present the thought that the feasting, sham-fighting and night dancing. . . . had the effect of empowering the child through rapport, of stimulating its growth, and endowing its spirit with those qualities that were being exhibited about it, which would enable it to take its place when grown as a distinguished leader in festivities, in social and political life, and among the communities fighters.

In thus providing opportunities for men and gods to mingle in activities enjoyed by both, at times when the influence of the gods was desired, amusements of a vigorous physical nature held an important place in Samoan religious life.

WARFARE

Warfare held quite a prominent place in Samoan life; everywhere men talked of the glory and honor to be gained on the field of battle.

Many of the games and sports of the islanders involved the same skills which were used in war, namely, those concerned with the handling of spears, clubs and slings. Specific amusements in which these were perfected were disc and stick throwing for distance, spear throwing for accuracy, spear parrying and

club fighting.

Although wars were frequent, the Samoans had no particular group of men who were especially trained for that purpose. All served as warriors and their principal form of training was participation in contests involving the above mentioned activities (2). Such contests were included in all of their social

gatherings.

In their battles, strength and endurance were factors to success. These elements were also important in victory at such sports as boxing, wrestling, kicking matches and club fighting. In fact, the natives preferred games involving great physical exercise and good wrestlers and club fighters were always praised (2). Games, by thus promoting the development of attributes essential in warfare, were of vital importance to it.

Some early writers even said that war, as practiced by the natives, was a form

of sport. One observer (29, p. 66) wrote:

The tribal wars have really been athletic sports.

ECONOMIC SYSTEM

Obtaining a livelihood was a co-operative enterprise, with the participants giving labor and receiving the fruits of labor according to their position of importance in Samoan society.

Activities involved in obtaining some of the economic necessities of life were

highly recreational in nature.

Fishing was a sport as well as a food procuring activity. Some of the community methods were occasions of fun and excitement and corresponded to a combined picnic and sports gathering that took place in the most important Polynesian playground, the lagoon (5, p. 517).

Pigeon netting, another means of getting food, was a highly developed sport restricted to those of rank.

Food was also obtained as a result of victory in games. Turner (26), Brown (2), and Stair (21), all report that the defeated party usually gave the winning

group some kind of food.

These inter-village competitions were of importance to the economic system in that they provided the incentive for host groups to produce goods to share with their visitors. Prestige came from sharing and giving, and each community strove to outgive all others when its turn came to sponsor a meeting.

EDUCATION

....boys and girls as pupils and servants of their elders learned the roles they were to play in adult life, while environmental conditions, fears, admonitions, and the urge to emulate and excel in forms of activity valued by the group all combined to harden the plastic material of their biological heritage along "Samoan" lines (14, p. 414).3

At an early age Samoan children started learning the games and dances of their people. They learned a great deal through observation and imitation, some

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through special instruction from slightly older children, with whom they played, and some through instruction from interested adults.

Except at informal village dances where they performed for the entertainment of all, children were not admitted as participants in adult amusements. They were, however, allowed to be present as spectators. Like children of today, most of their play was carried on with others of their own age.

The informal village dance had a special part to play in the education of the child. According to Mead³ (17, pp. 117-118):

The significance of the dance in the education and socialisation of Samoan children is two-fold. In the first place it effectively offsets the rigorous subordination in which children are habitually kept. Here the admonitions of the elders change from "Sit down and keep still!" to "Stand up and dance!" The children are actually the centre of the group instead of its barely tolerated fringes. Each child is a person with a definite contribution to make regardless of sex and age. The second influence of the dance is its reduction of the threshold of shyness. •

Samoan children seem not to have learned to work through learning to play as most primitive children did (17). They learned both to play and to work; each was important in itself. Any labor that they were capable of doing and which others did not desire to perform was given to them. Their play was like that of their parents in kind and interest (17).

Vigorous physical amusements also played a part in the education of the child in the ethics of his countrymen. Many of the Samoan proverbs, phrases and similes which served in this sort of training had their origin in specific sports (3). Pigeon netting seems to have produced more such sayings than any other activity (5).

Some Effects of Culture Contact

When the 18th century European explorers discovered the islands, the natives had a chance to observe people whose patterns of living differed from theirs. All of the newcomers who arrived, after the discovery, had some effect upon the lives of the Samoans. However, missionaries and government officials appear to have been more influential than the rest in instigating the culture changes which evolved.

CHANGES WROUGHT BY THE MISSIONARIES

When the first missionaries arrived in 1830, they found a people who were eager to learn about the new religion. Williams, the earliest missionary to arrive, had with him a converted Samoan of high rank who was extremely helpful in promoting Christianity in his native country. That Williams appreciated his ability is clearly shown in his missionary records; there (28, p. 332) he wrote:

In all our conversations with that individual, we were impressed with his intelligence, shrewdness, and good sense, but never more so than on the morning we arrived at the place of our destination, when he led us to a private part of the vessel, and requested us to desire the teachers not to commence their labours among his countrymen by condemning their canoe

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Although this study was made in the 1920's it is believed that the information on the role of the dance and the place of play in the lives of the people applies equally as well to the 1830's.

races, their dances and other amusements, to which they were much attached, lest in the very onset, they should conceive a dislike to the religion which imposed such restraints.

However, as the missionaries sincerely believed that some of these activities were detrimental to Christian living, they soon started encouraging the natives to renounce them. This was especially true of dancing, partly because some of it was of an erotic nature and partly because the early missionaries had a tendency to regard all dancing as immoral. They also frowned upon bathing and swimming on Sunday because these activities took too much time away from religious duties (27). Pigeon hunting expeditions, too, were discouraged, as they were believed to lead to immoral practices.

Many Samoans accepted and worshipped the Christian God. However, in accepting the faith of the newcomers the islanders did not find it necessary to

adopt other aspects of foreign culture (13).

With the discarding of the old system of worship some of the taboos which had restricted specific amusements to those of rank gradually lost their power. For example, natives of lower groups began to participate in pigeon netting, and bonito fishing. But, occasions at which individuals of rank engaged in these and other activities continued to be of prime importance.

With the acceptance of Christianity the religious festivals previously mentioned were discontinued. The vigorous physical amusements which had been a part of these events lost their religious significance. In spite of this they con-

tinued to be an important element in Samoan culture.

It is true that bans were placed on certain amusements (particularly dancing) and were effective in some places in eliminating these activities for a time; but, they were not permanently effective as the Samoans would not, or perhaps could not, without losing all zest for living, relinquish them.

That Christianized natives tried to follow these prohibitions is definitely stated in writings left by early island visitors. Perhaps the best way to show the actual results of these restrictions is to quote some of the pertinent observations made by such writers. Wilkes, who was in the islands in 1839 noticed that:

Their dances and other amusements are in a great degree abolished, but they are still practiced in the heathen villages, and even the Christian women may still be induced to exhibit the former, which they call the siva (27, p. 141).

From this report it can be seen that the bans were being followed to some extent.

In the 1860's Hood, who was traveling through Samoa, reported that:

In the evening we went to the dance. I believe all are not conducted so decorously as this was; were they so, it would be much better that the national amusement should not be discontinued, seeing that we give the light-hearted people no substitute in the way of pleasure (12, p. 48).

This observation, in addition to showing that dancing although prohibited had not entirely died out, brought out a fact expressed by others of that day; the fact that the missionaries offered no adequate substitute for the element of life which they sought to prohibit.

About 1890 the religious leaders also began to realize this truth. Robert Louis Stevenson, who lived in Samoa at that time wrote:

The native pastors (to everyone's surprise) have moved of themselves in the matter of native dances, desiring the restrictions to be removed, or rather to be made dependent on the character of the dance (22, p. 24).⁵

Thus, after years of religious opposition, dancing again became an accepted activity. However, during the struggle it had changed to some extent. The more erotic type of dancing which had been such an important part of the old dances had gradually disappeared.

CHANGES INSTIGATED BY OFFICIALS OF FOREIGN GOVERNMENTS

Foreign governments became involved in island affairs because their citizens settled there, and because of values which they expected to derive from the the area. The British were the first to make official alliances with some of the Samoan leaders. They were followed by the Americans and Germans and finally by the New Zealanders.

These governments were able to carry out certain of their political edicts because they could exert superior physical force if necessary. The islanders were aware of this fact, and acquiesced when it was impossible to do anything else.

In considering the changes which were made in vigorous physical amusements because of the actions of these powers, it appears that many were the result of their economic interests. For instance, when the traders first arrived they gave the islanders guns in exchange for native products. Before long the gun had taken the place of native arms in warfare. When these implements lost their place in war they started losing their place in the amusements of the people; kicking matches, club fighting, spear parrying, and disc throwing which had been important, gradually became events of the past (8). Spear throwing remained, perhaps because it was still essential in fishing and pig hunting.

Also, with the substitution of guns for native arms, fighting lost some of its attraction. Pritchard (20, p. 60), in speaking of a plan to end a particular war aptly demonstrated this fact. He reported:

The proposition was readily entered into by the Savaii people, as the opportunity to escape from a war in which, as they naively said, the victory was not won by the strongest arm in wielding the club or parrying the spear, for a youth only just tattooed could with a musket shoot the strongest and most daring warrior. This was the secret of the unpopularity of the war.

Eventually warfare was eliminated altogether, partly because it had lost some of its attraction, but primarily because the foreign governments became strong enough to put a stop to an activity which they considered extremely wasteful to economic effort.

As the powers gained influence, they all, at one time or another, placed some restrictions on travel for ceremony or sport. This was not done because the officials objected to the amusements of the Samoans, but rather because of the time which such visits consumed. They thought that if they could get the islanders

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to stay at home more often they might be induced to develop more systematic methods of agriculture.

These bans did not bring the desired results. The Samoans would work only so long as it took to obtain the things they wanted for immediate use. They continued to spend much of their time participating in vigorous recreational activities. In American Samoa, for instance, where inter-village cricket matches were forbidden except by special permits from May until February, the courts were filled with cases concerning the playing of cricket without permission (23).

The same foreign leaders who attempted to regulate sports meetings were responsible for giving the natives new games. In some of their moments of relaxation, they, too, enjoyed play. At such times they and their countrymen usually participated in games of their own native lands. The islanders observed

those activities and adopted the ones which appealed to them.

From the British they learned the sport of cricket. That game, in a modified form, soon became *the* sport of the Samoans. They had men's, women's and children's teams. All of the people of a village would accompany the men's team as it toured the islands to engage in contests with other villages. While away, such groups were freely housed and fed by their hosts. In these events all of the able-bodied men of both villages participated. Sometimes there were as many as two hundred on a team (7). A game consisted of a single inning and was finished when every player had had a chance to bat. This took anywhere from four to 12 days (9).

Cricket finally began to take so much of the natives' time and wealth that all

of the foreign powers made some regulations limiting its play.

Other major sports enthusiastically accepted by the natives were rugby and baseball. In these games, as in cricket, changes were instituted in order to make the games more compatible with Samoan play customs.

Thus, it can be seen that although foreign influence brought about several changes in the element of vigorous physical amusements, this element remained

an important part of Samoan culture.

Samoa in 1930

In 1930, after one hundred years of foreign influence, Samoan culture was not greatly changed from what it had been when the missionaries first arrived. Keesing (14, p. 477) attributed this to:

Samoa's smallness, isolation, and tropical climate, together with the political rivalry of the powers and the elements of disunity inherent in native polity.... 6

Buck (5, p. 5), in attempting to account for this phenomenon wrote:

The pleasure derived from the exercise of native institutions is perhaps the most important factor that has led to the persistence of Samoan customs and helped to resist the disintegration that has taken place in other parts of Polynesia.

Undoubtedly it was the combination of these reasons which enabled native life to stand fairly firm.

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It is true that many changes were made in their material culture and in those aspects of their social culture concerned with religion, warfare, education and government. Such changes, however, were gradual and were fitted into native living in a manner which enabled it to remain distinctively Samoan (4).

Amusements of a vigorous physical nature remained highly important. The natives still devoted so much time to them that American and New Zealand officials, who were then in control, saw fit to continue regulating intervillage meetings for ceremony and sport (14). In spite of this, traveling for ceremony and sport appears to have been the rule of the day (10).

Except for the changes pointed out in the section of this paper entitled "Some Effects of Culture Contact," the integration of Samoan recreational life with such major aspects of Samoan culture as their social, economic and educational systems remained much as it had been in 1830.

Summary and Conclusions

In an endeavor to add to the understanding of the contributions which the element of games, sports, dancing and other vigorous recreational activities has made in enriching the daily living of the diverse peoples of the world, the place of this element in Samoan culture was studied. Because Samoa was a fairly isolated area until a little over one hundred years ago, when it came in contact with Western culture, it was possible to discover pertinent information concerning the role of vigorous physical amusements in Samoan life before and after that event.

Before the advent of the Western powers a great deal of time was spent by individuals of all ages and ranks in a great variety of games, sports, and dances. Participation in these activities ranged from a few members of one village playing in an informal manner to the mustered forces of villages or districts competing in a formal manner for a championship in one or more events.

A critical examination of Samoan culture indicates the close inter-relationship of the social organization, religion, warfare, economic pursuits, and education with the recreational life involving vigorous physical activities.

- 1. In their social life the element of games, sports and dancing fulfilled the following needs:
 - (a) Provided social intercourse of a friendly and enjoyable nature through which group unity was promoted.
 - (b) Afforded socially approved outlets for feelings of rivalry.
 - (c) Provided for situations in which the leaders of the people were allowed to participate in select activities.
 - (d) Afforded the opportunity for groups of individuals to gain prestige and honor through victory in events highly approved by all.
 - (e) Provided an outlet for excessive emotions connected with the life crises of birth, marriage and death.
- 2. In their religious life vigorous physical amusements were important in that the natives believed that their gods derived great enjoyment from such diversions. For this reason, when they desired the influence of their deities they en-

gaged in elaborate religious rites in which various sports and dances held a prominent part. Particular amusements practiced at these events appear to have been of religious significance in the following ways:

(a) Club fights which were so fierce as to cause the blood to flow served to demonstrate their devotion to their gods. It was thought that for such devotion the deities answered prayers.

(b) Dancing of an erotic nature was believed to stimulate the gods and to cause them to bring about fertility in all of nature.

bring about fertility in an or nature.

- 3. Warfare in Samoan society was inter-related with the element of games and sports in that:
 - (a) The skills of war were perfected through the specific amusements of disc and stick throwing for distance, spear throwing for accuracy, spear parrying and club fighting. These events were favored by the Samoans and had a place in all of their social gatherings.

(b) The factors of physical strength and endurance which were essential for success in their games were also essential for success in their wars.

4. Some of their economic pursuits were highly recreational in nature. Fishing and pigeon netting were organized sports as well as food procuring activities.

5. In Samoan education, training the youth in the amusements of the people was considered essential in preparing them to take their place in adult society where such activities were highly significant. Training in dancing appears to have had a special place in their education. In this diversion they were given an opportunity to contribute something to the social life of their community without being reproved for presuming above their age. Such participation served also to help them overcome their feelings of shyness.

THE EFFECTS OF CULTURE CONTACT

The literature reveals that two major agencies of culture contact effected changes; the missionaries and official and unofficial representatives of foreign governments.

1. The missionaries who strenuously objected to Samoan amusements because they considered some of them as immoral and all of them as detrimental to true Christian living were influential in bringing about the following changes:

(a) Vigorous physical amusements lost their religious significance.

(b) Bonito fishing and pigeon netting which men of rank had been able to restrict to themselves because of their sacredness became sports of all.

(c) Dancing of an erotic nature was discontinued.

Even though the natives accepted Christianity; games, sports, and dancing continued to be highly important in their culture. As the years passed the missionaries became more broadminded and eventually realized the importance of such activities in promoting wholesome living.

2. Officials from foreign governments, traders and others whom they repre-

sented were instrumental in instigating the following changes:

- (a) Guns which they introduced changed the methods of warfare and led to the elimination of those amusements which had served in preparing warriors to use the native arms of the spear, club, and sling.
- (b) Travel for ceremony and sport was restricted.
- (c) Games which were played by the foreign element were adopted by the natives. Cricket, baseball, and rugby, all modified to meet Samoan play-methods became particularly important.

Except for the above changes, the interrelationships existing between the element of games, sports and dancing and the other major elements of Samoan life remained essentially the same as they had been in 1830. Despite the force of culture contact to which the Samoans were subjected, the native culture including the vigorous recreational life remained fairly stable and integrated.

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A Study of Some Personality Traits of Different Physical Activity Groups'

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To a physical educator it seems important to have some understanding of why some individuals prefer or respond to certain types of activities while other individuals may be reached by activities of quite different types.

Review of the Literature

There have been several studies directed toward exploring this problem. Sperling (12) has reported that personality differences, on a group basis, exist among participants in various sports. He found no significant personality trait differences between his varsity and intramural groups. However there were reliable differences in the personality patterns of the varsity and intramural groups as distinguished from those of the non-athlete group. Small and consistent, but not statistically significant personality trait differences existed between a combined group of varsity individual sport teams and a combination of varsity group sports teams. Non-contact sports teams were similar in personality pattern to the individual sports group.

A personality schedule including items from the Thurstone neurotic inventory and ascendance-submission items was administered by Henry (9) to student pilots, track squad athletes, physical education majors, and students enrolled in weight lifting. In the extreme group the physical education majors were found to be significantly lower than the weightlifters in total scores and in the ascendance-submission and Thurstone parts separately. Lower scores indicated the physical education majors to be less neurotic and more ascendant. They were also significantly lower in trait constellations concerning social introversion, hypochrondriac and neurasthenic syndromes, inferiority, hypersensitivity, and possibly in self-consciousness, and self-insufficiency, but not in cycloid tendency. In the intermediate group the athletes and aviators had nearly identical schores. They were significantly more neurasthenic than the physical education majors and less introverted and hypochondriac than the weightlifters.

In another study Henry (10) administered the Cozens General Athletic Ability Test and an interest and attitude inventory (same as above) to a group

¹ From the Research Laboratories of the Department of Physical Education, University of California, Berkeley. The writer is indebted to Dr. Franklin M. Henry for advice and criticism during the course of this investigation.

of sixty-one college students. Henry concluded: "There is a positive correlation between general athletic ability and conventionally favorable attitudes about physical education; also, between athletic ability and ascendance, particularly ascendance in physical situations. The correlation tended to be highest with performances demanding extreme sustained physical exertion and lowest with agility and coordination."

The Interest and Attitude Inventory used by Henry was also used by Derian (3) when he tested a group of 36 football players and compared their responses to a control group of 345 students at the University of California who had been given the inventory by Henry prior to the war. Although the two groups were not strictly comparable (being prewar and postwar) the results were consistent with other studies. The football group had lower mean scores for the following traits: social introversion, self consciousness, and inferiority. They were more

gregarious and ascendant. Critical ratios ranged from 3.25 to 5.07.

Thune (13) administered a personality inventory to 100 YMCA male weight-lifters and to 100 other YMCA male athletes (non-weightlifters) in an effort to determine group differences in attitudes and dispositions of personality. An analysis of the data led him to conclude that training with weights probably appeals to a group that differed with respect to interests, attitudes, and perpersonality from the rest of the active YMCA membership and that his differentiating items indicated that the members of the weightlifting group felt more strongly than the controls that their health had improved, that basically they were shy, that they lacked self confidence, and that they did not obtain satisfaction, through participating at a loss, in the more traditional physical activities. They wanted to be strong and dominant, emulating other strong men. There is evidence from the above studies that personality trait differences do exist among groups, segregated according to those who have a free choice of types of physical activity.

From casual observation and from discussions with other physical education instructors, the writer has gained the impression that, among physical activity groups, fencers can be characterized as being more dominant in their behavior, more feminine, and more extroverted than groups engaged in badminton, basketball, volleyball, boxing, and swimming. As a contrasting group, volleyball players seem to be depicted as being more submissive in their reactions, more introverted, and less emotionally stable than groups engaged in fencing, badminton, basketball, boxing, and swimming. Students enrolled in badminton, basketball, boxing, and swimming would be expected to fall somewhere between

the two extreme groups-volleyball and fencing.

It would seem to be of value to a physical educator to know more about the personality characteristics of individuals going into a specific sport. Perhaps they could be guided into some activity somewhat similar but at the same time differing in some respects so that a specific personality type could be benefited. For example, volleyball players could be encouraged to engage in a sport such as boxing or basketball where a more dominant and extroverted behavior is exhibited.

Method

A thorough search of the literature on personality analysis revealed that the two most favored techniques in the field are the laboratory or clinical analysis, and the standardized test procedures. The latter method of approach was decided upon for several reasons, in particular the limitation of the investigator's training for carrying out the procedure of clinical analysis. It is true that the inventory method has been criticized as being more superficial than the clinical method (4) (5); however it has been widely used in psychological studies (4).

It seemed reasonable to use a personality inventory that would investigate the traits that the author believed might exist among various physical activity groups.

Since no single inventory included all the traits expected in the groups studied, various sources were explored in search for suitable items. The final form of the inventory made use of the following sections:

- 1. The items of factor M (masculinity-femininity) from the Guilford-Martin Inventory, (6).
- 2. Allport's Ascendance-Submission Scale, (2).
- 3. The Guilford's Introversion-Extroversion Scale, (7).
- 4. The Emotional Stability section of Smith's Human Behavior Inventory, (11).2

On the basis of the anticipated types of personality differences among the specific activity groups, as discussed earlier in the paper, it can be seen that the resultant composite inventory samples the area of interest fairly completely. Nothing can be said of the over-all validity of the inventory. However it consists of appropriate parts of inventories that have been widely used in psychological studies. An exception is the *emotional stability* scale. The justification for using this scale is the fact that Sperling obtained positive results with it (12).

The resultant personality inventory consisted of 123 items. The first 97 of these (1–3 above) were to be answered by a (Yes-?-No) choice, and the remaining 26 items were to be answered according to a five-point scale which best described each individual's reaction to the item. The five-point scale is as follows:

A-Always, F-Frequently, O-Occasionally, S-Seldom, N-Never

The writer tried, as nearly as possible, to conform with each author's original method of scoring the answers on each personality trait included in the inventory and at the same time considered ease of administering the inventory and the recording of data. This necessitated a change from the original manner in scoring the Ascendant-Submission items.

For the first 97 items it was felt that a questionable (?) answer might be revealing as to the way an individual reacted to a certain situation. It was decided to count a questionable (?) answer as one which went in the direction away from the cultural stereotype for the male since there was some doubt in his mind as to a clear-cut division.

³ Anyone interested in the items used in the inventory may obtain a copy of the complete questionnaire from the writer.

For the first part of the questionnaire it would have been possible for an individual to score a total of zero points to 31 points on the ascendant-submissive scale, the total score dependent on the way he reacted to the statement. Likewise he could have scored anywhere within the range zero to 37 on the masculinity-femininity scale and zero to 32 on the introversion-extroversion scale. Because of the five-point scale of grading on the emotional stability items, it was possible for a subject to score within a range of minus fifty-two to plus fifty two, using values of 2, 1, 0, -1, -2 for the degree of agreement or disagreement to the item.

In order that the individual tested would not so readily discern the personality traits included in the inventory, items comprising each trait were spaced at each third question in so far as the writer could control, but in a few items, near the end of the inventory, it was necessary to place together two items of the same trait because of an unequal number of items in each category. The emotional stability items had to be placed consecutively because of a different

grading scale.

Of the 97 items comprising the first part of the questionnaire, 31 contained ascendant-submissive items, 37 were masculinity-femininity items and 32 questions were introversion-extroversion items. Three items were contained in both the ascendant-submissive and the introversion-extroversion scale.

The following is a description of the traits contained in the items above:

Ascendance-Submission. The nature of ascendance is described as an individual's tendency to dominate others and to take an active role in social face to face situations, to manifest organizational, executive, and administrative qualities. Submission is characterized by an individual's disposition to yield, agree, placate, or take a passive role in face to face situations. G. W. Allport (1) points out that each of these traits is separate even though they are cast into a single continuum for convenience in scales. Submission is not merely the absence of ascendance and vice versa.

Masculinity-Femininity. From the frame of reference of the test maker it is scored as more "feminine" to dislike activities which are concerned with things rather than persons and this reaction is exaggerated if the items suggest contact with dirty things or mechanically complicated things. It appears to be "feminine" to like items which suggest aesthetic appreciation, refinement, romance, full-dress affairs, and fashionably dressed people, and it seems to be masculine

to dislike these items.

Introversion-Extroversion. Introversion is characterized by individuals who are withdrawing in social attitude, emotionally oversensitive, and deliberative in behavior. Extroversion is pictured by individuals who are highly sociable, overtly express their emotions, are adaptive to new situations, are not emotionally oversensitive, and are out-going in their interests.

Emotional Stability-Emotional Instability. Individuals who are emotionally stable are those who are relatively free from such neurotic symptoms as phobias (abnormal fears), compulsions, obsessions, frequent nightmares, insomnia, sleep walking, shifts of moods without apparent cause, uncontrolled outbursts

of temper, and excessive worries. Individuals who exhibit the opposite symptoms are pictured as emotionally unstable.

Procedure

Six physical activity groups from the University of California who were taking a physical education class in a voluntary type of program were studied. The following physical activity groups were used: (1) fencing, (2) basketball, (3) boxing, (4) swimming, (5) volleyball, and (6) badminton. The basis for choosing these particular groups was stated earlier. Physical education is completely elective at this University, hence there is no reason other than the predilection of the men that would cause them to choose one rather than another of these activities. The activities are given equal publicity and emphasis in the department announcements and schedules. All of the men enrolled in these classes met twice weekly over a period of 15 weeks. Three of the activity classes, volleyball, badminton, and swimming, were tuaght by the investigator and all of these men were known by name. The majority of the other individuals engaged in the three remaining groups were known, though some not as well as the volleyball, badminton, and swimming groups. Necessary rapport was thus established.

Varsity sports are conducted in each of the six activities mentioned above with the exception of badminton. All of the classes used in the study included beginner, intermediate, and advanced players. The investigator personally administered, with uniform instructions, and collected a total of 221 copies of the questionnaire. Of this number 36 sets were from fencers, 23 from badminton players, 38 from basketball players, 48 from volleyball players, 39 from boxers, and 37 from swimmers. No mention was made of the fact that this was a personality inventory. In order to disguise the purpose of the testing the writer characterized the inventory as an attitude and interest survey and emphasized the fact that there were no right or wrong answers. Printed instructions on the first page of the inventory explained in detail how the items were to be answered.

In a few instances a subject enroled in more than one of the activity courses used in this study during the semester in which the survey was conducted. Four subjects were taking swimming and volleyball concurrently, three were talking both boxing and swimming, two were enroled in badminton and basketball, volleyball and basketball, and swimming and basketball. Five combinations of activity courses had one subject enroled: badminton and volleyball, fencing and swimming, boxing and volleyball, basketball and fencing, and volleyball and fencing. In these cases the activity in which the individual had participated more semesters was considered his predominant choice. If the subject were taking more than one activity course and had taken them for an equal number of times the present semester enrolment was considered.

Treatment of the Data

The scores on the inventories for all six groups were recorded and organized in frequency distribution tables. From these tables were obtained means, standard deviations, and standard errors of the means for each group on the respective personality traits measured by the scales. The statistical technique by which the comparisons and analyses were carried out included critical ratios between means and where borderline cases existed, the chi-square test. In addition, the "t" ratio was also computed in comparing each group with the total of the other five groups in scores on each trait. Again, where borderline cases existed, the chi-square test was also used.

In Table 1 the means, standard deviations, and standard error of the means are listed.

TABLE 1
Means, Standard Deviations, and Standard Error of the Means on the Personality Inventory

Activity Group	A-S*	M-F	E-I	ES-EI
Fencing $(N = 36)$				
Mean	17.96	22.50	18.80	27.21
SD		3.71	5.53	9.92
S _m		0.62	0.93	1.60
Badminton $(N = 23)$				1.00
Mean	17.35	23.72	19.90	26.60
SD	5.50	4.56	6.20	11.80
S _m		0.97	1.32	2.52
Basketball ($N = 38$)				
Mean	15.91	24.18	17.46	26.38
SD		3.91	5.23	8.93
S _m		0.64	0.86	1.46
Volleyball (N = 48)				
Mean	15.24	23.58	16.60	20.80
SD	4.16	4.52	5.26	12.38
S _m		0.51	0.77	1.81
Boxing $(N = 39)$				
Mean	16.90	24.00	18.15	24.48
SD	4.24	4.00	4.71	8.77
S _m		0.65	0.77	1.42
Swimming $(N = 37)$				
Mean	16.22	24.15	18.31	24.90
SD		4.13	6.10	10.90
S _m	0.00	0.66	1.03	1.68

A.S = Ascendance-Sub nission; M-F = Masculinity-Femininity; E-I = Extroversion-Introversion;
 ES-EI = Emotional stability-Emotional instability.

In Table 2 are shown the critical ratios between groups for the different personality traits. Analysis of these data show that differences, some of statistical significance, have been obtained. For the trait Ascendance-Submission the fencers indicate themselves to be more ascendant in their behavior than all of the other groups, but it is statistically certain in only two groups, volleyball, and basketball. Critical ratios range from 0.45, when compared with badminton players, to 2.85 when compared with volleyball players. Volleyball players are willing to say in effect that they are more submissive than all of the other groups. Mean scores are lower but are not significant except in two cases, fencing and boxing. Critical ratios range from 0.69 when compared with basketball players to 2.85 when compared with fencers.

Badminton players, boxers, swimmers, and basketball players fall in between the two extreme groups of fencers and volleyball players and indicate themselves to be ascendant in the order named above.

The Masculinity-Femininity section of the inventory reveals that fencers, as a group, indicate on the average that they are more feminine in their reaction than any of the other groups, but it is not statistically significant. Critical ratios from 1.07 to 1.90 were obtained when the fencers were compared with badminton players and basketball players respectively. Critical ratios for all other activity groups fall within that range. Basketball players profess to have the highest degree of masculinity, followed by groups in swimming, boxing, badminton, volleyball, and fencing.

TABLE 2
Critical Ratios Between Groups for the Different Personality Traits

F	Fencing	Badminton	Basketball	Volleyball	Boxing	Swimming
A-S Fencing. Badminton Basketball. Volleyball Boxing.		0.453	1.97	2.85* 1.63 0.69	1.05 0.34 -0.99† -2.42	1.29 0.78 -0.27 -0.91 0.60
M-F Fencing		-1.07	-1.90 -0.40	-1.20 0.12 0.66	-1.67 -0.24 0.20 -0.46	-1.84 -0.37 0.03 -0.60 -0.16
E-I Fencing		-0.69	1.07 1.58	$\frac{1.84}{2.20} \\ \hline 0.76$	0.54 1.16 -0.61 -1.44	0.36 0.97 -0.65 -1.35 -0.10
Swimming ES-EI Fencing. Badminton. Basketball. Volleyball. Boxing. Swimming.		0.25	0.38 0.08	2.64 1.87 2.43	1.26 0.75 0.91 -1.59	0.96 0.53 0.65 -2.03 -0.19

[·] Significant scores are underlined,

Badminton players show a trend toward being more extroverted than any of the other groups, the greatest difference being between badminton players and volleyball players with a critical ratio of 2.20. Fencers follow closely behind badminton players and are exceeded only by badminton players in the degree

[†] Figures favor activity group listed at left, i.e., they are more ascendant, masculine, extroverted, or emotionally stable, unless preceded by a minus sign, which indicates the converse.

TABLE 3

Hi-Squares Between Groups Where Borderline Cases Existed

	Group	*X	ы	Group	×	4	Group	×	Ь	Group	×	а
0 4	Fencing	7	20 0 0	Fencing	7 40	7 40 0 01	Boxing	1 11	1 47	Badminton	1 5	3
V-10	Basketball	3	3	Volleyball	2	5	Volleyball	4.4	3.5	Volleyball	71.7	2.72 0.10
4	Fencing	10	0 00									
A-IV	Basketball	1.71	3.5									
F	Fencing	5	0 04	Badminton	20	20 00	r					
12	Volleyball	3.12 0.01	70.0	Volleyball	3.22	20.05						
101 001	Fencing	2 02	0, 0, 10	Basketball	20	20 0 02						
ES-EI	Volleyball	7.31	0.10	Volleyball	2.5	20.0						

of extroversion. Volleyball players indicate themselves to lean more toward introversion. In the trait Extroversion-Introversion the various activity groups rank themselves in the following order: Badminton, fencing, swimming, boxing, basketball, and volleyball.

The trait Emotional stability-Emotional instability shows more differences of significant importance than any other category included in this study. Fencers profess to be more emotionally stable than any other group with critical ratios ranging from 0.25 when compared with badminton players, to 2.64 when compared with volleyball players. Volleyball participants show themselves to be more emotionally unstable than all other groups. In order of decreasing possession of emotional stability are fencers, badminton players, basketball players, swimmers, boxers, and volleyball players.

Since none of the critical ratios showed statistical significance at the 0.01 level of probability and only a few showed statistical significance at the 0.05 level of probability a farther test was carried out which subjected the borderline cases to closer scrutiny. Table 3 shows the results when Chi-Square technique was applied to the groups needing farther study. Yates correction for continuity was used (8). With a probability, P, of 0.01, which means that this result could occur in the same manner only once in 100 times, we can therefore accept a P of 0.01 as very significant. P's of 0.02 to 0.10 are classified as less significant indicating that that result would occur twice, or 10 times in a 100 times.

TABLE 4
"I" Ratio Comparing Each Group with Mean of Net Composite Groups

Group	A-S	M-F	E-I	ES-EI
Fencing.	1.94	-1.93*	0.84	1.54
Badminton	1.58	0.002	1.42	0.74
Basketball	-0.79	0.75	-0.65	1.11
Volleyball	-2.08	-0.18	-1.86	-2.18
Boxing	0.58	0.46	0.17	-0.19
Swimming	-0.32	0.66	0.28	0.09

Negative scores indicate the degree of submissiveness, femininity, introversion and emotional instability as shown by the various groups.

When comparisons were made with one group against a mean score of the net composite groups in Table 4, "t'" ratios were obtained to see which group differed from the total groups with respect to the personality traits considered in the inventory. Fencers were found to be significantly detached from the total group in regards to ascendance and femininity but scores in the other two categories were not of statistical significance (8). The only other scores of reported significance show the volleyball players to be more submissive and more emotionally unstable. Other groups, when compared with the total groups, show no significant differences.

Subjecting Table 4 to closer scrutiny, where doubt existed as to the significance of results, the Chi-Square technique was again applied in Table 5. P's of 0.02 to 0.08 were obtained, thus confirming the results reported above.

TABLE 5
Chi-Squares for Borderline Cases in Table 4 Above

Trait	Group	X ³	P
A-S	Fencing -vs- All others	3.92	0.05
A-S	Volleyball -vs- All others	5.27	0.02
M-F	Fencing -vs- All others	1.56	
E-I	Volleyball -vs- All others	2.97	0.08
ES-EI	Volleyball -vs- All others	3.33	0.06

Discussion of Data

It must be pointed out that this study in no way attempted to investigate individual differences within a group but rather the relationship between groups that might be expected to exist.

The original hypotheses that fencers and volleyball players, as a group, would show deviations from other groups of men engaged in physical activity classes has been partially proved. But other groups have been similarly detached in a likewise manner.

Differences, some of statistical significance, have been obtained. Fencers, as a group, indicated by their inventory scores that they were more ascendant than any of the other groups taking a class in badminton, basketball, volleyball, boxing and swimming. The highest significant difference, critical ratio, 2.85, was obtained when the fencers were compared with volleyball players. The lowest group in ascendance scores, and calling them more submissive, were the volleyball players. In no instance did a critical ratio favor the volleyball players in ascendance.

Masculinity-Femininity scores indicated the fencers to be more feminine, as a group, than any of the other groups tested. Critical ratios ranged from 1.07 when compared with badminton players, to 1.90 when compared with basketball players. Basketball players were willing to say that they were the most masculine group but significant differences did not exist except between basketball and fencing. Swimmers and boxers showed more masculine traits than badminton and volleyball players but it was not as pronounced a difference as with the basketball players.

Fencers indicated by their scores that they were more extroverted than any of the other groups with the exception of badminton players. But whereas badminton players professed to be more extroverted than fencers, the fencers' scores are more significantly meaningful when other groups are compared with them. Again, volleyball players showed themselves to be more introverted than

any of the other groups.

The trait Emotional stability-Emotional instability showed more differences of significant importance than any of the other categories included in this study. Fencers, again, profess to be more emotionally stable than any of the other groups with critical ratios ranging from 0.25 when compared with badminton players, to 2.64 when compared with volleyball players. Basketball players, C.R. 2.43, and swimmers, C.R. 2.03, are more emotionally stable than volleyball players. The volleyball group showed themselves to be more emotionally unstable than any of the other groups.

Although many of the above discussed differences are significant in the statistical sense it should be observed that these differences represent in fact a variation between groups of means which vary only a few points. We must not overstate the degree of Ascendance-Submission, Masculinity-Femininity, Extroversion-Introversion, and Emotional stability-Emotional instability.

In looking at the fencing and volleyball groups as a whole the writer gained the impression that fencers demonstrated the personality traits mentioned above because fencing, being an individual sport, requires more extroversion and a more dominant personality for success. Fencers cannot depend on other team members to win for them. Observation of fencing groups over a number of years has led the writer to believe that they are "exhibitionists," especially when performing before a feminine audience. This belief has been substantiated.

On the other hand, volleyball players, demonstrated the afore-mentioned personality characteristics because the nature of that activity is such that individual effort and accomplishment is not as demanding for success. Association with volleyball players has led the writer to believe that they take the activity course because they feel inferior in athletic ability and think that volleyball participation will give them the feeling of "belonging."

It must be borne in mind that the majority of the differences found in this study are only trends. Larger groups may have shown more statistically reliable differences as revealed by a personality type inventory. Ideally, an interview or projective type personality test should have been used by the investigator but reasons listed in the introduction prohibited that technique of testing.

Another fact that must be kept in mind is that only approximately 75 percent of the inventories-passed out were returned to the investigator. The writer felt that the remaining 25 per cent who were taking the activity courses but were unwilling to co-operate in the study might have made the study more significant.

Summary and Conclusions

A personality inventory was assembled for the purpose of studying the personality traits of fencers and other physical activity groups. The inventory consisted of four different types of items, measuring Ascendance-Submission, Masculinity-Femininity, Extroversion-Introversion, and Emotional stability-Emotional instability.

The inventory was administered to six groups of male college students who were taking activity courses on a voluntary basis in fencing, badminton, basketball, volleyball, boxing, and swimming at the University of California. A total of 221 students participated in the study.

Results of the personality inventory showed group differences, some of statistical significance, with respect to the four personality traits. Fencers indicated by their test scores that they were more ascendant than basketball players, volleyball players, and boxers, the differences being statistically significant at the three, one, and three percent level of probability respectively. Fencers also professed to be more feminine than basketball players—statistically significant

at the three percent level of probability. Badminton players demonstrated in terms of their inventory responses that they were more extroverted than volley-ball players—this difference being significant at the two percent level. Volley-ball players are more emotionally unstable than basketball players, which is

statistically significant at the two percent level of probability.

Since there was no selective influence other than the free choice of the subjects in determining what physical activities they participated in, it is concluded that groups who spontaneously select one physical activity course in preference to another physical activity course demonstrate that personality is a factor in making that selection.

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Individual Differences in Oxygen Metabolism of Work at Two Speeds of Movement

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The mere presence of differences between the scores of individuals in some particular physiological measure does not establish individual differences in that function. Assuming that the *true* measurements were exactly the same for all (i.e., that there were no individual differences), individual scores as observed would differ because of inherent tendency for the function to vary randomly about a mean value, in addition to variable environmental and other factors including error of measurement. It follows that to evaluate individual differences, it is necessary to separate out that part of the variation between the scores of individuals that characterizes individuals rather than fluctuations in their scores. To do this requires that individual scores must be observed on two separate occasions to establish the stability of the function and intra-individual variance, and that sufficient individuals must be tested to establish the differences between individuals. Hence, the vocabulary of individual difference studies is necessarily statistical.

One of the few investigations of individual differences in exercise physiology is that of Taylor (4), who found that 40 per cent of the variance in gross oxygen consumption of 31 men during moderate exercise was due to *intra*-individual variance. Another is the study of Berg (1) on individual O₂ and CO₂ recovery curves of 28 men following moderate exercise, showing that only 67 percent of the individual variance in O₂ debt was due to individual differences.

Method

Since any large scale application of routine measurements of individual differences in oxygen economy would be dependent upon the availability of a simplified system of testing, the present investigation utilized the closed circuit method employed in other studies from this laboratory (2). In order to insure that the work was, insofar as possible, independent of the bodily weight of the subjects, the exercise was performed on a bicycle ergometer. Two kinds of work were used—the first at the near optimum speed of 69 rpm. with a load of 620

¹ The work described in this report was supported in part by contract W-33-038 ac-21260 between the Air Materiel Command, Wright Field, and the University of California.

kg.m./min; the second at an inefficient 116 rpm., with a load of approximately 95 kg.m./min. Preliminary experiments had indicated that this load was nearly equal in metabolic costs to the slow-movement work. Thirty-five subjects did two tests with the slow-movement work; 25 of these also did the fast-movement work. Time of day was standardized for each subject, although it varied between subjects. The test-retest interval was a week or less in half of the cases, and three weeks or less for nearly every one. The subjects were young male college students, mostly 25 or 26 years of age. They were accustomed to a physically active type of life, but were not in training for competitive athletics.

In addition to securing from the records the obvious measures such as current O₂ income during exercise and O₂ debt, semi-log plots of detailed O₂ intake during recovery were made, and individual "alactic" debt recovery curves were

fitted to the exponential equation

$$y = a e^{-kt}$$

which gives the rate of O_2 intake (y) at any time (t), based on the peak intake (a) at the beginning of recovery. For all measures, resting O_2 requirement was subtracted to secure net values.

Results and Discussion

Statistical Aspects. It is important to know the nature of the individual score distributions of the oxygen metabolism measures in order to a describe the norm adequately, and because precision of interpretation and flexibility of analysis are achieved most readily with 'normal curve' statistics. The analysis summarized in Tables 1 and 2 show that the scores listed there are normally distributed. The χ^2 test of goodness of fit between the theoretically expected number of cases in each score interval for a normal curve of the same mean and standard deviation as the sample, and the number of cases observed experimentally, shows no case of a significant difference. The largest χ^2 is 3.5; it would have to be 7.8 to indicate any real departure from normality.

However, the half-time recovery curve constants as used by Berg (1) do not seem to be normally distributed—instead, they tend to pile up in the long half-time region as evidenced by the cumulative frequency ogive of Figure 1. Since the data in this graph are plotted on a probability-scaled ordinate, the data would show a linear trend if the score distribution were normal, whereas the trend is towards a reciprocal curve for half-times of both slow-movement work (Fig. 1) and fast-movement work (not shown). Hence it is better to use the normally distributed velocity constant k as a measure of rate of recovery. Reliability, in particular, will be over-estimated if the distributions are skewed.

Several ratio indices of the O_2 debt— O_2 income relationship have been used as measures of O_2 transport efficiency, e.g. O_2 income/ O_2 cost of work, or "submaximal O_2 ratio" (3). This measure also yields a skewed distribution, the ogive giving a reciprocal rather than linear probability plot in both slow movement work (Fig. 2) and fast movement work (not shown). This is also true for the ratio O_2 debt O_2 cost of work (2). Insofar as individual difference rankings are con-

TABLE 1

Statistical Summary of O₂ Economy Measures on 35 Young Men Doing 3,100 kg.m. of Work in Five Minutes at 69 Pedal rpm.

(O₂ measures corrected to S.P.T.D.)

Measure		5	Score dist	ribution			X2	Mean	S
O2 income (liters)	3.2	3.6	4.0	4.4	4.8	5.2+	0.9	4.46	0.497
Per cent expected	4.1	13.4	27.4	30.2	18.1	6.8			
Per cent observed	4.3	15.7	21.4	31.4	20.0	7.2			
O2 debt (liters)	0.6	0.8	1.0	1.2	1.4	1.6+	0.2	1.18	0.233
Per cent expected	5.1	16.7	31.4	29.4	13.8	3.6			
Per cent observed	5.7	18.6	30.0	30.0	11.4	4.3			
O2 cost (liters)	4.0	4.5	5.0	5.5	6.0	6.5+	0.7	5.64	0.624
Per cent expected	3.2	11.8	25.7	30.7	20.0	8.6			
Per cent observed	2.8	15.7	24.3	28.6	20.0	8.6			
Income/debt	2.0	2.6	3.2	3.8	4.4	5.0+	3.5	3.90	0.807
Per cent expected	5.4	13.9	25.8	28.3	18.1	8.6			
Per cent observed	7.1	12.9	21.4	17.2	11.4	10.0			
Peak O2 intake (a)	0.7	0.8	0.9	1.0	1.1	1.2+	0.9	1.04	0.123
Per cent expected	2.3	9.7	23.5	32.1	22.2	10.2			
Per cent observed	1.4	12.9	25.7	27.1	22.9	10.0			
Velocity constant (k)	0.50	0.65	0.80	0.95	1.1	1.25+	0.6	0.925	0.176
Per cent expected	5.9	17.4	32.2	28.5	12.8	3.2			
Per cent observed	7.2	15.7	35.7	24.3	11.4	5.7			

TABLE 2

Statistical Summary of O₂ Economy Measures on 25 Young Men Doing 477 kg.m. of Work in Five Minutes at 116 Pedal rpm.
(O₂ measures corrected to S.P.T.D.)

Measure		5	Score dis	tribution			χ^2	Mean	S
O2 income (liters)	3.5	3.8	4.1	4.4	4.7	5.0+	0.7	4.44	0.426
Per cent expected	6.6	14.5	25.0	26.5	18.3	9.1			
Per cent observed	6.0	18.0	24.0	26.0	14.0	12.0			
O2 debt (liters)	0.5	0.7	0.9	1.1	1.3	1.5+	1.0	1.18	0.258
Per cent expected	3.2	10.8	23.9	30.1	21.3	10.8			
Per cent observed	4.0	6.0	24.0	34.0	24.0	8.0			
O2 cost (liters)	4.4	4.8	5.2	5.6	6.0	6.4+	1.6	5.64	0.612
Per cent expected	8.5	15.1	23.8	24.8	17.1	10.7			
Per cent observed	12.0	12.0	24.0	18.0	22.0	12.0			
Income/debt	1.9	2.6	3.3	4.0	4.7	5.4+	3.0	3.94	0.903
Per cent expected	7.0	17.1	28.7	24.9	17.0	5.3			
Per cent observed	6.0	18.0	34.0	26.0	6.0	10.0			
Peak O2 intake (a)	0.80	0.88	0.96	1.04	1.12	1.20+	1.0	1.04	0.120
Per cent expected	9.2	16.2	24.7	24.6	16.1	9.2			
Per cent observed	12.0	18.0	20.0	20.0	20.0	10.0			
Velocity constant (k)	0.6	0.7	0.8	0.9	1.0	1.1+	3.1	0.863	0.130
Per cent expected	10.5	20.9	29.8	24.2	11.2	3.4			
Per cent observed	12.0	26.0	22.0	22.0	12.0	6.0			

cerned, there is no loss of information by substituting the O_2 transport ratio O_2 income/ O_2 debt, which is normally distributed as shown in Tables 1 and 2. The ratio O_2 cost / O_2 debt would necessarily be normally distributed also, since it is simply O_2 income/ O_2 debt plus unity.

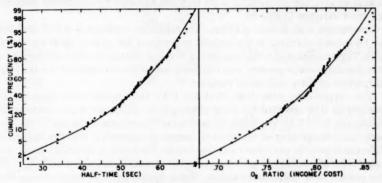


Fig. 1. (left). Frequency distribution of half-time recovery constants. Fig. 2. (right). Frequency distribution of submaximal O₂ ratios.

Individual Differences. It is convenient for purposes of analysis to employ variance coefficients (i.e. S^2 , the squared standard deviations) as these are additive. Table 3 shows the sources of variance that go to make up the total variance in individual scores, using the nomenclature and statistical methods employed by Taylor (4). Error of method was determined by the differences in two independent readings of the respirometer tracings by different technicians. In the case of the velocity constant k the coefficients were independently determined from semi-log plotted graphs of O_2 debt and k's computed from peak O_2 intake and O_2 debt measured from the respirometer tracings. This procedure may have over-estimated the error. Possible systematic errors such as large breathing amplitude or inadquate CO_2 absorption during the first few moments of recovery would have resulted in faster apparent recovery. Apparently these errors were negligible since recovery rates were slower than in the Berg series.

It is noteworthy that the test-retest correlation, or reliability coefficient, is in the case of normal distributions identical with the proportion of total variance that is due to true inter-individual variation S_a , and thus is in itself a straightforward measure of the amount of real individual differences present in a series of test scores.

Limitations of Method. It must be conceded at the outset that the closed circuit method contributed a much larger proportion of error variance than would have been the case had the Douglas bag-Haldane analyzer system been used—e.g., the data of Taylor (4) on gross O₂ consumption during moderate exercise using the latter method show that only 0.6 per cent of total variance is due to method. The present data, concerning net rather than gross O₂ consumption,

² The published figure is 0.3 percent, but the actual variances were 0.00017 for error and 0.0286 for total. In any case, the figure is small.

allocate 8.5 percent to error of method. While this is a much larger proportion, nevertheless it is small compared with other sources of variance, hence is not a limiting factor in the measurement of individual differences. This statement also holds true for the other measures studied, as may be seen by the small change in variance proportions when they are adjusted by completely eliminating error variance (Table 3).

Comparison with Results of Others. The reliability coefficients of 0.55 and 0.69 for O₂ income obtained in the present experiment are in very good agreement with Taylor's figure of 0.59, confirming the fact that individual differences in this function, while present, are relatively unstable as evidenced by the large

proportion of intra-individual variance.

The oxygen debt reliabilities, 0.41 and 0.45, tend to run lower than the coefficient of 0.67 reported by Berg although the difference is not statistically significant (t = 1.5). His subjects were quite heterogeneous in age in contrast with the homogeniety of the present sampling, suggesting that his individual differences were in part due to an age factor. He found a reliability coefficient of 0.55 for the half-time recovery velocity constant, compared with 0.57 for the present slow movement exercise. These figures agree in emphasizing that intra-individual variance is about as large as the true individual difference variance.

Inter-correlations Between Measures. Inter-relations of individual scores in the different measures have been calculated for each run separately, and the results averaged (Table 4). Differences in O_2 intake are more highly related to differences in current O_2 income, debt and O_2 cost of exercise in the fast-movement work than in the slow; there is also a definite relation between body weight and the O_2 measures in the fast-movement exercise but not in the slow. Otherwise, the two types of exercise have the same pattern of intercorrelations.

There is a notably high intercorrelation between the velocity constant of debt pay-off k and the income/debt ratio—r=0.87 when the two exercise conditions are averaged—indicating that k is probably a measure of O_2 transport efficiency rather than a biochemically-determined velocity constant as is implied by the term *alactic* debt. Additional confirmation comes from the observation that both indices show a low test-retest reliability in the case of fast-movement work—r=0.21 and 0.20—although their inter-relation is high—r=0.83. When an individual's O_2 transport efficiency is high, his O_2 debt is small and he has a fast rate of *alactic* debt pay-off and when it is low he develops a larger debt and his pay-off rate is slow, even though individual differences in transport efficiency are relatively unstable from day-to-day or week-to-week.

The income/debt ratio and k have a remarkably similar pattern of correlations with the other measures as shown by a simplified factor analysis (Table 5). Both correlate approximately zero with total O₂ cost of work, emphasizing a necessary distinction between efficiency of O₂ transport and metabolic efficiency of work. Both show only low correlations with current O₂ income—0.22 and 0.17 when the results with the two kinds of work are averaged—although the inter-individual differences are more reliable in income than in any of the other

TABLE 3
Sources of Variance in Individual Oxygen Measures

		Slow M	ovement			Fast M	ovement	
Measure	(S _G) ² Inter- indi- vidual	(S _p)² Intra- indi- vidual	(S _M) ² Method	(S _T) ³ Total	(S _G) ² Inter- indi- vidual	(S _p) ² Intra- indi- vidual	(S _M) ² Method	(S _T) ² Total
O ₂ income (liters) Variance Proportion	.135	0.91	.021	.247 1.000	.125	.041	.015	.181 1.000
Adjusted	.60	.40	_	1.00	.75	.25	-	1.00
O ₂ debt (liters) Variance Proportion	.0222	.0308	.0013	.0543 1.000	.0300 .451	.0345	.0020	.0665 1.000
Adjusted	.42	.58		1.00	.47	.53	_	1.00
O ₂ cost (liters) Variance Proportion	.185	.182	.022	.389	.230 .613	.128	.017	.375 1.000
Adjusted	.50	.50	_	1.00	.64	.36	_	1.00
Income/debt (ratio) Variance Proportion	.310 .477		40	.650 1.000	.173	.6	41 88	.814 1.000
Peak O ₂ intake (a) VarianceProportion	.0070	.0073		.0151 1.000	.0088	.0047	.0009	.0144 1.000
Adjusted	.49	.51	-	1.00	.65	.35	-	1.00
Velocity constant (k) Variance Proportion	.0141 .455	.0132	.0037	.0310 1.000	.0034	.0114 .675	.0021	.0169 1.000
Adjusted	.52	.48	_	1.00	.23	.77	-	1.00

TABLE 4

Inter-correlations Between Several Aspects of Oxygen Metabolism During Exercise and Recovery (The correlation coefficients for slow movement work are above and to the right of the diagonal; fast movement below and to the left.)

	Oxygen income	Oxygen debt	Oxygen cost	Income/ debt	Peak intake	Velocity constant	Body weight
O ₂ income	0.74	0.45	0.90 0.53	0.31	0.75 0.47	0.26 -0.74	0.36 -0.03
O ₂ cost	$0.98 \\ 0.13$	$0.84 \\ -0.53$	-0.04	0.09	$0.80 \\ -0.06$	-0.06 0.90	0.26 0.12
Peak intake (a) Velocity constant (k)	0.91 0.08	$0.86 \\ -0.49$	$0.94 \\ -0.05$	$-0.08 \\ 0.83$	-0.02	0.08	0.32 0.11
Body weight	0.62	0.33	0.60	0.22	0.61	0.05	

measures studied. Both show substantial correlations, 0.68 and 0.62, with O_2 debt. Inasmuch as these two indices are calculated from quite different aspects of the oxygen consumption records, the existence of the high intercorrelation between them and the similar correlation patterns with the other variables is a good argument for the adequacy of the method used. The coefficient k has the virtue of being uninfluenced by work load within wide limits.

The significance of the peak O_2 intake coefficient a as a measure of individual differences in O_2 economy can also be evaluated. While quite uncorrelated with k, this coefficient together with the velocity constant k describes the alactic O_2 debt according to the exponential expression ae^{-kt} . Averaging the results with both exercises, 45 percent of the debt variance³ is accounted for by a, 39 percent is accounted for by k, and the remaining 16 percent is due to errors in curvefitting and possibly inexactness of the formula since there may have been some second component or *lactic* debt present. Yet the correlation of a with O_2 cost of work is 0.87, on the average, and its correlation with current O_2 income, 0.83, is higher than with debt, namely 0.67. Income correlates only 0.60 with debt. Apparently a and O_2 income, in the case of steady state work, chiefly sample the factor of individual differences in O_2 requirement (this may not be true for maximal work).

TABLE 5

Profile Analysis of Inter-correlation Patterns
(Slow and fast-movement results are averaged. The index of reliability is used for the self-correlation between items)

			(1)	(2)	(3)	(4)	(5)	(6)
O ₂ transport factor	$_{k}^{\text{income/debt}}$	(1)	0.59 0.87	0.87 0.58	$0.03 \\ -0.06$	$-0.07 \\ 0.03$		-0.68 -0.62
O ₂ requirement factor	$\begin{cases} O_2 \text{ cost} \\ a \\ Income \end{cases}$	(3) (4) (5)	$ \begin{array}{r} 0.03 \\ -0.07 \\ 0.22 \end{array} $	$-0.06 \\ 0.03 \\ 0.17$	$0.74 \\ 0.87 \\ 0.94$	0.87 0.73 0.83	0.94 0.83 0.79	
Mixed factor	{O ₂ debt	(6)	-0.68	-0.62	0.69	0.77	0.60	0.65

Viewed in this light, the use of the gross measure O_2 debt as an indicator of the efficiency of an individual's physiological adjustment to exercise is an oversimplification, since the debt is made up of two independent individual difference components—the one, k, being a measure of differences in O_2 transport efficiency, whereas the other, a, is unrelated to individual differences in either of the two measures of O_2 transport efficiency, and essentially reflects the skill of the individual in doing the standard test exercise with low metabolic cost, coupled perhaps with individual differences in frictional energy loss or other sources of inefficiency in the muscular system.

This hypothesis predicts that practice with the exercise should reduce a and leave k and income/debt unaltered. Data are at hand to examine this idea,

^{*} In the case of inter-correlations, the proportion of variance is r^2 , rather than r as in the case of reliability coefficients.

since nearly all of the subjects did the first slow-movement exercise first, whereas the second slow-movement test was usually their third or fourth exercise bout. The coefficient a drops from 1.07 to 1.01 with a statistically significant t ratio of 2.3, whereas k changes insignificantly from 0.936 to 0.914 with a t of only 0.7. The income/debt ratio does not change at all between the first and second tests.

Inter-exercise relationships. While the two exercises are very similar with respect to metabolic cost of the work, they are decidedly different in amount of external work accomplished and in amount of leg movement, offering the possibility that O₂ transport during exercise or perhaps other measures might show a differentiation. Since the equating of the exercises had to be done in advance, it was imperfect. For this reason, the subjects have been arranged into one group whose members showed well-matched individual metabolic costs of the two exercises and another group in which the metabolic cost was less in the fast-movement work. Data from two exercises of the same type have been averaged for each subject. The results given in table 6 show that the difference in type of exercise had no observable influence on the group averages. Even in the unmatched group, the averages of the measures concerned with O₂ transport are unaffected by the type of exercise.

Table 6 also gives the inter-exercise correlations. Here, single test rather than average scores have been used, but the correlation coefficients for the first test and re-test have been averaged to simplify the table. Since test-retest reliability coefficients are available for all measures, it has been possible to correct the correlations for attenuation due to unrealiability (4). The corrected coefficients represent the theoretical relation between so-called 'true scores' in the various

functions.

The results of the inter-exercise comparisons are difficult to interpret. There are individual differences in O_2 requirement measures such as total cost, current income and a in the case of fast movement exercise, but stable inter-individual differences in O_2 transport measures are negligible, hence it is only possible for the former group of functions to be common to both fast and slow work. The absence of O_2 transport individual differences does not invalidate the comparison of means in table 6, for even if individuals were more alike than different

TABLE 6
Inter-exercise Differences and Correlations Between Slow-Movement and
Fast-Movement Exercises

-	Matched M slow		N = 10)		ed group M fast	(N = 12)	Inter-e correla Uncorrected	ations
O2 income	4.46	4.49		4.47	3.50	21.6	0.52	0.84
O2 debt		1.26		1.22	1.02	4.5	-0.01	-0.02
O2 cost	4	_	-	11			0.33	0.57
Income/debt	3.68	3.61	0.43	3.87	3.52	0.82	0.08	0.39
Peak O2 intake	1.06	1.04	0.49	1.03	0.82	2.48	0.39	0.67
Velocity constant	0.88	0.83	1.25	0.90	0.87	0.56	0.07	0.23

in these functions, it would be entirely possible for a differential factor such as amount of limb movement to have an effect.

The reason why intra-individual rather than inter-individual differences tend to characterize fast-movement work is not clear at the present time. It is possible that irregularity of work-technique may eventually prove to be the important factor. In any case, large intra-individual differences occur and the inter-individual differences in the three O₂ requirements measures become small

when the correlation with body weight is taken into account.

Correlations with Resting Oxygen Consumption. Individual measures of this function were apparently established with relative accuracy, as pre- and post-exercise measurements correlate r=0.81. There are no significant correlations between resting O_2 and any of the exercise metabolism measures of the slow-movement exercise. The largest—r=0.21 with a—represents only a random difference from zero. In the fast-movement exercise there are several correlations that are statistically significant—r=0.51 with exercise income, 0.37 with debt, 0.51 with O_2 requirement, 0.56 with a, but only 0.02 with income ratio and 0.19 with k. Since the O_2 requirement measures have considerable correlation with body weight, which also is definitely correlated with resting O_2 , it is not surprising that these correlations with resting O_2 substantially disappear when the common factor of weight is removed by the technique of partial correlation (4). It should be mentioned that it would be incorrect to attempt to remove the weight factor by using the ratio exercise-metabolism/weight, as it is only fractionally proportional in fast-moving cycling.

Summary and Conclusions

Norms are presented in the form of means, standard deviations and frequency distributions of measures of O₂ income, debt, requirement and transport efficiency for 35 young men of homogeneous age who did 3,100 kg. m. of work in five minutes at 69 rpm. on a bicycle ergometer. Norms are also given for 25 of the men who did a fast-movement exercise at 116 rpm. with a work load of 477 kg. m., having the same metabolic cost as the other task.

Direct O_2 consumption measurements have a normal curve distribution. The half-time debt recovery coefficients, as well as the O_2 transport efficiency ratio, O_2 debt/ O_2 requirement and O_2 income/ O_2 requirement, yield skewed score distributions. Normal curve distributions are found for their reciprocal forms, namely the velocity constant k of the exponential recovery formula ae^{-kt} , and

the oxygen transport ratio O2 income/O2 debt

Intercorrelations between the different aspects of exercise metabolism, when subjected to a simplified factor analysis, categorize the debt velocity constant k as a measure of individual differences in O_2 transport efficiency, whereas the peak recovery O_2 intake a measures individual differences in O_2 requirement. Hence O_2 debt, a composite of these two unrelated factors, could easily be misinterpreted as a measure of differences in physiological adjustment to work.

When a person has poor O₂ transport there is a large O₂ debt and a slow rate of pay-off, while with good transport there is a small debt and a rapid pay-off,

but the individual O_2 requirement and O_2 income may be high, low, or intermediate in amount in either case. Nevertheless, O_2 requirement and O_2 debt are positively correlated. Practice with the exercise reduces O_2 requirement but

does not influence O2 transport efficiency.

Inter-individual differences are present for all measures in the slow-movement exercise, although they are on the average no greater than intra-individual variance. With fast-movement work, stable inter-individual differences are almost non-existent in the O_2 transport measures. While present in the case of O_2 requirement measures, they are largely due to the tendency of heavier men to have a higher O_2 requirement.

Resting O₂ intake is not significantly correlated with any of the slow-movement exercise metabolism measures. Statistically significant correlations are found between resting and fast-movement O₂ requirement but these relation-

ships effectively disappear when the weight factor is partialled out.

Oxygen transport is not more efficient in the fast-movement exercise, as compared with the slow. Apparently the change in speed of movement of the limbs is not within a range that produces any improvement in circulation through the veno-massaging action of the working muscles.

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An Improved Tape for Measuring the Chest Girth

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In measuring chest girth one of the common errors is caused by the slipping of the tape on the back of the subject while reading is being taken in the front. This, of course, is due to either lack of experience or carelessness on the part of the examiner and can be avoided.

The other common error consists of placing a finger under the tape to hold one end of the tape against the chest while the reading is being taken. This error is also avoidable, but nevertheless is often observed. As the result of these errors data obtained on the same subjects by different examiners may show such discrepancy that they become useless. This is especially true during mass examinations, when examiners are pressed for time.

The Department of Statistics of the Army Air Forces School of Aviation Medicine calculated coefficients of correlation for test-retests on 230 subjects done in a routine manner at a classification center. For the chest at expiration it was 0.76 and for the chest expansion it was 0.37.

Purpose of the Tape Development

In order to facilitate securing more reliable data the present tape was developed.

Description of the Tape. (See Figure 1.) The tape is made of a nonstretchable, waterproof material, one-half inch wide and 48 inches long. To one end (E) of the tape is attached an elastic band (B) eight inches long and between one half and one quarter of an inch wide. The free end of the band has a flat metal hook which can be fastened to one of the eyelets (I) of the tape when it is placed around the chest. The tape has nine such eyelets (I) made at one-inch intervals between the 21st and 29th inch marks. Also at the end (E) of the tape is securely attached a flattened metal sleeve (S) through which the free end of the tape is passed when measurements are made. The zero mark of the tape is located at the left hand edge of the sleeve (examiner's left).

Use of the Tape. (See Figure 1.) The subject is asked to make a full expiration. The tape is then placed around the chest, and the elastic band is slightly stretched and is hooked to one of the eyelets. The free end of the tape is then passed through the sleeve (S). The final position of the tape is shown in Figure 1b. With the elastic band holding the tape securely around the chest it is easy to retain it in a horizontal position, and the tape will not slip after several deep

¹ This tape was developed at the Army Air Forces School of Aviation Medicine, Randolph Field, Texas. Project 24, Report 1, October 5, 1942.

respirations. The readings are taken at the left (examiner's left) hand side of the metal sleeve.

The use of an elastic band may raise objections because its tension varies with the degree of stretching. It is obvious that a stiff elastic, during a great expansion of the chest might considerably compress the soft tissues of the chest, especially in obese patients, thus giving incorrect figures for the chest

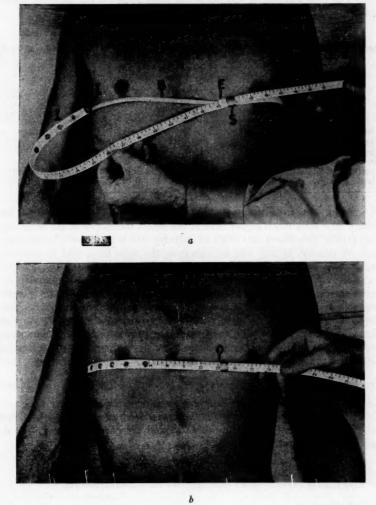


Fig. 1a. The improved measuring tape. B—an elastic band sewn at E to the tape and having a flat hook which is inserted into an eyelet I. S—a metal sleeve attached to the end, E, of the tape. The other end of the tape is passed through this sleeve and reading is taken as shown in Fig. 1b.

expansion. Numerous tests have shown, however, that an elastic band which stretches about one inch for each three-quarters of an ounce of pull gives entirely satisfactory results.

Reliability of the New Tape. Two well trained assistants took chest measurements on 99 medical doctors using the ordinary and the improved tapes. The measurements were done according to the Army Air Forces regulation AR 40-105. The tape was placed just below the lower angles of the shoulder blades and the nipples. The statistical data are presented in Table 1.

TABLE 1

Statistical Data Obtained in Test-Retest of 99 Subjects, the Ordinary and the Improved Tapes being Used by Two Well-Trained Examiners

	First E	raminer	Second E	xaminer		Difference	8
Test Used	Mean Inches	Stand- ard De- viation	Mean Inches	Stand- ard De- viation	Mean Inches	Stand- ard De- viation	Correl. Coef- ficient
Ordinary tape					3		
Chest at expiration	34.74"	1.88"	34.82"	1.84"	0.08"	0.48"	0.97
Chest expansion	2.73"	0.67"	2.65"	0.72"	0.08"	0.53"	0.71
Improved tape				7			
Chest at expiration	34.76"	1.84"	34.69"	1.80"	0.07"	0.45"	0.97
Chest expansion	2.35"	0.57"	2.30"	0.61"	0.05"	0.39"	0.78

It may be seen from this table that the coefficients of correlation for the ordinary tape were much higher than in the report mentioned in the beginning of this article. This shows that when an ordinary tape is used carefully, measurements are reliable. It may also be seen from the same table that an ordinary tape, when carefully used, is just as reliable as the improved tape. The question then arises—what is then gained by the improved tape described in this article? Numerous tests on beginners showed that it is much more difficult to make wrong measurements with the improved tape than with the ordinary one. This is the main advantage of the new tape. The second advantage is the ease with which several consecutive measurements during various respiratory phases can be made. In spite of the movements of the chest the tape remains in the desired position and the readings can be easily taken.

Summary

- 1. A new tape for measuring chest girth was developed.
- 2. The main feature of the tape is the presence of an elastic band holding securely the tape in the desired position around the chest and preventing its slipping during respiratory movements.
- 3. The new tape makes measurements easier and helps to avoid some of the common errors.
 - 4. This tape is recommended especially for mass measurements.

Acknowledgement

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An Evaluation of the Educational Aspects of Boxing as a College Activity

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BOXING, as a sport in universities and colleges, has been lauded by some and severely attacked by others. Some authorities firmly believe that boxing is an activity comparable in value with other acceptable physical education interests, and that it should be soundly developed in the sports program on a par with other athletic activities. Others equally experienced in the field of physical education are firmly convinced that boxing is hazardous, that it fosters dangerous relationships, and, that in many other respects, it is not desirable as an educational activity. The problem involved in college boxing would appear to be to keep it "boxing" and still maintain its collegiate atmosphere rather than foster its professional aspects. Boxing, to many people, is a sport utilizing strength and power properly controlled by sound thinking in the light of educational value. Perhaps the ideal in collegiate boxing can be expressed by the following quotation:

The Greeks and Romans kept boxing in its proper relation to everyday life, not as a brutal exhibition of skill or strength, but as a healthy exercise to invigorate the body, expand the chest, strengthen and quicken the muscles, and render mind and body free, supple, strong, and confident.²

This is an educational plane upon which college boxing might well be sustained. The mere existence of a boxing program does not automatically guarantee that it is an excellent one, or that it is being conducted upon the proper educational level. There is need for a careful study of the college boxing situation to provide information for its evaluation. Such were the considerations which supplied the impetus for the present study.³

Procedure

In order to ascertain which colleges and universities in the United States offered boxing of some form in their physical education curricula, a preliminary

¹ Kearney, H. E., E. A. Thacker, M. D., and H. C. Gebhart, "The Evaluation of Boxing as a College Activity," Research Quarterly, 80:93 (March, 1940).

² John Boyle O'Reilly, Athletics and the Manly Sport (Boston: Pilot Publishing Company, 1890), p. 1.
³ The data presented herein comprised an integral part of the Master's thesis "An Evaluation of the Educational Aspects of Boxing as a College Activity" done in the graduate school of Physical Education at the University of California, Los Angeles.

postcard inquiry was sent to the head of the Physical Education Department of 665 colleges and universities in the United States and Territories. The book American Universities and Colleges (fifth edition) was used as a guide, as it contains all the accredited colleges and universities listed by the American Council on Education. The only colleges and universities not included in this preliminary survey were the ones whose student body was made up strictly of female students.

From the results of this prelimnary survey a questionnaire containing a letter of explanation was sent to each of the 260 colleges and universities that indicated that they offered boxing as class instruction, intramural, or intercollegiate competition, in their physical education program. The questionnaire was sent to the Head of the Physical Education Department and contained specific questions concerning boxing to be answered by him, the boxing coach or instructor in charge of boxing, and the team physician.

From these questionnaires the author received 147 returns or a 57 percent reply to the six-page questionnaire, answered in full or in part, as they were able.

In addition to the investigation made of the boxing programs and facilities of colleges and universities throughout the United States, a survey of the literature in this field was made in order to get a clearer understanding of the status of boxing from the professional, amateur, and collegiate standpoint.

Findings from the Postcard Inquiry

From a preliminary survey of 671 postcards mailed, the writer received a total of 472 or a 71 percent response. Of this total, 212 had no boxing at their institutions in any form, which is approximately 45 percent of the number returned. Nine percent of the above number made a short notation indicating they wished a summary of the study as they were considering the advisability of including boxing in their curriculum.

TABLE 1

Various Combinations of Boxing Programs in College As Obtained from Postcards

Combinations	Number	Percent
Number not having boxing in any form	212	47
Class instruction only	107	22
Intramural and class instruction	68	14
Intramural, intercollegiate, and class instruc-		
tion	33	7
Intramural only	19	4
Intramural onlyIntercollegiate and class instruction	16	3
Intercollegiate only	12	2
Intramural and intercollegiate	5	1

Of the total number of cards returned, 55 percent of 260 indicated that boxing in some form was conducted at their institutions. Though these returns de-

termined the institutions which would receive the questionnaire, they also revealed some interesting information in advance. Table 1 indicates the manner and combinations in which boxing is conducted in the institutions from which the preliminary request was made.

Summary of Findings from the Questionnaire

 Types of Boxing. This study indicates that class instruction is the most common type of boxing program carried on in colleges and universities, fol-

lowed in order by intramural and intercollegiate boxing.

2. Participation. Even though many schools offered boxing as a class activity, participation was not extremely high as compared with the major sports. The average participation was approximately 30 percent of the male enrollment. Only 20 percent of the schools required majors to include boxing in their professional preparation, although it was felt by 66 percent of the administrators that interest in learning how to box was relatively high, as against 20 percent who did not feel that interest in the activity was important enough to include boxing in the curriculum. Of the schools studied, 38 percent had intramural boxing as against 51 percent who did not. In these schools, from 60 to 70 students participated in intramural boxing. Relatively few colleges, 23 percent, offered intercollegiate boxing as against 60 percent who did not. There were from 20 to 25 students active on these intercollegiate teams. Only 9 percent of the schools conducted freshman competition in boxing.

The median male enrollment of the institutions studied was 1,050. The

average in physical education service courses was 425.

3. Participation in Other Contests. Thirty-six percent of the administrators were opposed to the practice of allowing students to enter contests outside of college competition compared with 39 percent who were in favor of it. The remaining 25 percent did not offer an opinion concerning the question. It was noted that the schools allowing this practice did not have intercollegiate boxing since it is against intercollegiate boxing rules to participate in outside contests.

4. Eligibility. The requirements for participation in intramurals have as their chief objective the safety of the student. Conditioning, as well as medical examination, were required, and every effort was made to keep intramural

boxing on a strictly novice level.

There were 25 schools that allowed men with other than school experience to participate on their collegiate team as against 23 schools who did not.

5. Popularity. The popularity of boxing is somewhat indicated by the fact that 51 percent of the heads of departments felt that boxing was popular with the student body as against 22 percent who felt that it was not a popular activity.

It was indicated that a very small percent plan to offer intramural and intercollegiate boxing in the future as compared with those who do not plan to offer either one. Nineteen percent were considering including class instruction in their future program as against 9 percent who were not.

6. Attendance. Only 13 percent of the schools did not open their matches to the public, and only 5 percent were against this practice. The consensus of

opinion seems to be that boxing contests should be on a spectator basis and open for attendance to the general public.

7. Instruction and Supervision. Fifty-one percent of the colleges required instruction before participation in intramurals. Only 6 percent failed to include

this practice of safety.

It is to be noted that 25 percent of the schools allowed students to use facilities without supervision, as against 39 percent who required an instructor to be present. Nineteen percent allowed team members to box without supervision, but 31 percent required a coach to be present when the team members were boxing.

8. Qualifications of Personnel. In general, it appeared from the data that relatively high qualifications are required of persons who are to instruct boxing. Most administrators desire that their boxing instructors be the equivalent in academic standing of other members on the physical education staff. It was noted that 16 institutions required the master's degree.

9. Qualifications for Referees. Experience and knowledge of rules rate high on the list of qualifications for a referee. Another chief qualification was that

the referee be primarily concerned with the safety of the boxer.

10. Length of Competitive Season. The length of the competitive season was found to be approximately two and one half months. During this time the school participated in from six to seven matches. Thirty-three percent of these schools required a physical examination before each match, as against 5 percent who did not. In preparing for these matches, 16 of the schools allowed their men to box three times a week.

11. Boxing Rules. In comparison with 7 percent of the administrators who felt that the intercollegiate boxing rules were not satisfactory, 36 percent were of the opinion that they were satisfactory. There were three recommendations made concerning changes needed in the Collegiate Boxing Rules. These were: (1) the wearing of head gears; (2) 75-second rounds in intramurals; (3) the required termination of a bout when the match is unequal. Forty percent of the doctors felt that head gears should be worn at all times as against 12 percent who felt it did not make any difference. There were a few colleges, 13 percent, which participated under Amateur Athletic Union Rules, as against 54 percent who participated under National Intercollegiate Boxing Rules. Thirty percent allowed draws to be called in intercollegiate competition, while 11 percent did not allow such a practice.

12. Length of Rounds. In all of the schools but three, the rounds in bouts were of two minutes duration. Also, all but four schools allowed one-minute rest between rounds for intramural and intercollegiate competition. The majority of schools followed the conventional one-minute rest period between rounds

for class instruction.

The majority of schools had two-minute rounds in their class instruction and intramural boxing, although 22 schools advocated one-minute rounds.

13. Criteria for Matching. Of the total number of administrators contacted, 56 percent felt that body weight classification alone was not an entirely satis-

factory criteria for matching contestants. Only 14 percent felt that it was satisfactory. In addition, experience and skill were recommended as desirable criteria for equal matching of opponents.

14. Academic Standing. Of the colleges who had intercollegiate teams, 44 percent felt that the grades of boxers were average. Twenty percent felt that

their grades were above average. The remainder were of no opinion.

15. Facilities and Equipment. According to the coaches, special devices to reduce injuries were requirements for most participants. Only eight doctors recommended the use of head gears, but the majority felt that proper instruction and supervision would reduce a great number of injuries. The majority of the schools followed the required specifications of the Collegiate Boxing Association for their ring specifications. The ones who did not were institutions in which intercollegiate boxing was not offered.

The most popular size of gloves used in class instruction was 16 ounces and for intramural participation 14 ounces. The only size used for intercollegiate

boxing was 12 ounces, as specified by intercollegiate rules.

Most coaches required their students to wear head gears, aluminum cup supporters, hand wraps, and teeth protectors; the former being the most common.

16. Problems with Professional Managers. Only 8 percent of the coaches stated that they had trouble with professional managers soliciting their men to sign up for professional boxing. Of this number, no more than two members of their team had taken up boxing as a profession.

17. Medical Examination. The heads of departments were 100 percent in agreement with the practice of requiring a complete medical examination of

all students enrolled in physical education.

The majority advocated that the medical examination be given yearly. A few stated that the examination was given only upon entrance as a freshman.

Thirty-nine percent of the schools advocated that a physician be present at all matches as against 10 percent who did not follow this practice. Fifty percent of the schools also had the physician easily accessible during all boxing instruction periods, as against 23 percent who did not. Twenty-seven percent did not give an opinion.

18. Injuries. Lack of proper conditioning and improper instruction were the most often repeated reasons given for injuries in boxing and would appear to

be correctable by proper supervision.

Of 60 schools, only one had had any cases of *Dementia pugilistica*, and it had noted two cases. Only 9 per cent of the doctors answering the questionnaire had noted personality changes.

The majority of the knockouts incurred from participation in boxing was stated to be from one to five. Technical knockouts ranged from 10 to 12.

There was 100 percent agreement that matches should be stopped when the participant was taking undue punishment. The opinion was evenly divided on stopping matches when the participant was losing decisively, even though apparently not being injured.

19. Hazards. In the opinion of the administrators, it seems that boxing is less hazardous than football or basketball and more hazardous than wrestling or baseball.

Random participation was judged to result in the greatest number of injuries both by the doctors and administrators. Next in order came intercollegiate, intramural, and class instruction.

Fifty-two percent of the administrators expressed the fact that the prime objective in the teaching of boxing is not the injury of an opponent; 20 percent felt that it was.

20. Health Aspects. Concerning the questions answered by the team physicians regarding the health aspects of boxing, the doctors felt that class instruction was the least hazardous, followed by intramural and intercollegiate boxing. Intercollegiate boxing was considered to be the most hazardous. Twenty percent of the doctors felt that boxing was not a healthful sport, as against 40 percent who were in favor of boxing.

Regarding amnesia, 56 of the doctors had not noticed any cases of amnesia,

as against 8 who had. Relatively few cases were reported.

There were only four deaths attributed to sports in general in college, and no deaths were attributed to college boxing from cardiac inhibition or other types of injury.

There was not much evidence of personality changes among college boxers. Nine percent of the doctors said they had noted some changes in personality. The exact rating of these personality changes was not clarified.

Among various conditions observed in college boxers, headaches and dizzi-

ness appear to be the most often noted.

The main criteria recommended by the doctors in deciding when an intercollegiate bout should be stopped were bleeding, severe laceration, and impaired state of consciousness or co-ordination.

There were 18 percent of the doctors who could give evidence that sudden and intermittent loss of weight was injurious to the future health of the in-

dividual, as against 38 percent who could not.

21. Educational Aspects. The administrators of physical education departments, the boxing coach or instructor, and the team doctors, all agreed that boxing tends to develop positive aspects of personality, such as sportsmanship, self-confidence, will to win, and other desirable mental attitudes. Only three percent felt that boxing developed negative aspects of personality.

The administrators felt that boxing did not offer unique educational benefits that could not be gained in other sports. The boxing coaches or instructors

were about evenly divided on this question.

Concerning the positive aspects of boxing versus the negative aspects there was agreement among the administrators, coaches, and doctors that the evidence in favor of boxing was significant enough to warrant its inclusion in the program under organization and supervision.

The educational reasons given by administrators, coaches, and doctors as to why boxing should be included in the curriculum were practically identical.

Development of confidence ranked first on all the lists. Next came self-defense

and physical development.

22. Reasons for and Against the Inclusion of Boxing in the Program. Only about two percent answered this specific question, but a majority of those interviewed agreed in answering other questions that there were few valid reasons why it should not be included. Two of the most common favorable comments given were: (1) good supervision yields worthwhile results; and (2) boxing contributes to the development of the physical well-being. On the other hand, a few of the administrators and doctors felt that it was a dangerous sport because of repeated blows to the head.

Conclusions and Recommendations

From a consideration of findings, in general, the following conclusions seemed warranted:

1. It would appear that boxing in colleges and universities is not a fast-growing sport. However, the evidence at this time indicates that approximately 30 percent of students participate in some form of boxing. This is relatively high, considering the individual nature of the sport. Evidence also supports the conclusion that student interest in learning how to box is relatively high.

2. It was concluded that random participation in boxing is a most dangerous practice. As has been pointed out, more injuries occur through unsupervised use of facilities than in intercollegiate boxing contests, which ranks next in order, with class instruction resulting in the least number of injuries.

It is recommended that unsupervised use of facilities never be permitted. Also, only those men with high qualifications should teach boxing and referee

matches.

It is recommended that a physician be present at all matches and be quickly available during practice sessions. A complete medical examination should be given to each participant before intramural and intercollegiate competition. There should be adequate instruction given before participation in intramurals.

3. It was concluded that, in general, the National Intercollegiate Boxing Rules were considered satisfactory and that a majority of college teams fol-

lowed these rules.

However, it was recommended that the following criteria be given consideration in modification of these rules: (1) experience and skill in the matching of contestants; (2) required wearing of head gears; (3) calling of draws; (4) seventy-five second rounds in intramurals; and (5) the stopping of uneven

fights before injury occurs.

4. A majority of the doctors, administrators, and coaches felt that boxing, under proper conditions, was a healthful sport, and *Dementia pugilistica* was not found to be common among college boxers. Not many knockouts or technical knockouts were listed as occurring, and administrators, coaches, and doctors agreed that matches should not be allowed to continue until knockouts occur. No deaths were reported from boxing. Very few cases of amnesia were reported. The observations of doctors cover on the average of three and a half years with a low of one year and a high of 24 years.

It is recommended, in order to keep the same conditions and improve upon them, that proper instruction and good physical condition be stressed above all else by those who are in charge of boxing.

5. It was concluded that the positive educational aspects of boxing, when properly conducted, outweighed negative aspects. However, it was also concluded that boxing does not offer any unique educational benefits that cannot be gained in other sports. The main educational reasons for the inclusion of boxing in the program were essentially as follows: (1) development of confidence; (2) knowledge of self-defense; (3) and importance in physical development.

6. Considering the general findings from this study the writer feels that under the proper conditions boxing may be included in the program and have definite educational value. From the evidence gathered in this study these conditions are stated to be as follows:

- (a) A complete medical examination should be given before competition.
- (b) The doctor should be present at all bouts and within easy reach during practice.
- (c) Participants should be in good physical condition with sufficient instruction to enable them to "take care of themselves."
- (d) The boxing instructor should be of the highest caliber with considerable experience in the sport.
- (e) National Intercollegiate Boxing Rules should be followed, and extreme care should be taken in the matching of contestants.
- (f) Equipment should be of the best obtainable, and each participant should be fully equipped.

Existing and Desired Physical Education Activities in 126 Illinois Secondary Schools

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THE data reported here were supplied by 126 boys' physical education department heads and 126 girls' department heads from the State of Illinois. The information has been selected from a study sponsored by the Illinois Secondary School Curriculum Program.¹

Procedures

COLLECTING DATA

Inventories were sent to 139 schools (121 high schools and 18 junior high schools) which had already participated in one or more projects of the Illinois Secondary School Curriculum Program. Responses were received from 126 heads of departments of physical education for boys and from 126 girls' department heads. Percentage of response was 90.6. Questions asked included: (1) what activities are now included in your program?, (2) what activities would you like to add if time, personnel, and facilities permitted?, (3) to which activities would you like to allot more time?, (4) to which activities would you like to allot less time?

TREATMENT OF DATA

Data were tabulated for each of several school classifications as well as for total schools. Classifications selected were (1) high schools with enrollment under 200, (2) high schools 200 through 699, (3) high schools above 700, and (4) junior high schools.

Percentage of response was calculated for each activity at each of the several grade levels with respect to: (1) present activities, (2) activities not now included but which department heads believe desirable, (3) activities which department heads believe should receive more time, and (4) activities to which department heads would like to devote less time. Present activities were compared to the results of two earlier studies of a similar nature. Variety of activities now offered and variety desired were compared (roughly) to standards suggested by the Illinois Office of Public Instruction.

¹ Practices and Opinions in Physical Education, Health, and Safety. Circular Series A, No. 51, Illinois Secondary School Curriculum Program, Bulletin No. 14, Vernon L. Nickell, Superintendent of Public Instruction, State of Illinois, 1951. The Bureau of Research and Service, University of Illinois, provided technical leadership and financed a large part of the project. C. W. Sanford, Director, Illinois Secondary School Curriculum Program, 204 Gregory Hall, Urbana, Illinois, will supply more detailed information upon request.

TABLE 1
Number and Percentage of the 126 Schools That Now Offer the Various Activities to High School Boys

	All S	chools		Schools der 200		Schools 0-699		Schools ove 700	Juni-	or High
Activities	N = 126		N = 36		N = 38		N = 34		N = 18	
	No.	%	No.	%	No.	%	No.	%	No.	%
Basketball	122	96.8	36	100	38	100	30	88.2	18	100
Volleyball	119	94.4	36	100	37	97.4	28	82.3	18	100
Conditioning (calisthenics,	440	02.6	24		25	07.4	20	00.0		
workouts, etc.)	118	93.6	34	94.4		97.4		88.2	17	94.
Softball	112	88.8	31	86.1		89.5		88.2	17	94.
Touch football	103	81.7	28	77.8		92.1	23	67.6	17	94.
Track and field	102	80.9	28	77.8		84.2		73.5	17	94.
Games and relays	102	80.9	24	66.7	35	92.1	25	73.5	18	100.
Tumbling, stunts, pyramids.	91	72.2	22	61.1	27	71.0	26	76.5	16	88.
Soccer	74	58.7	22	61.1	24	63.1	13	38.2	15	83
Testing	63	50.0	13	36.1	19	50.0	20	58.8	11	61.
Wrestling	60	47.6	13	36.1	17	44.7	23	67.6	7	38.
Table tennis	53	42.1	17	47.2	21	55.3	8	23.5	7	28.
Boxing	43	34.1	15	41.7	13	34.2	11	32.3	4	22.
Badminton	42	33.3	15	41.7	14	36.8	8	23.5	5	27.
Speedball	40	31.7	9	25.0		44.7	9	26.5	5	27.
Social dancing	39	30.9	11	30.5		36.8		23.5	6	33.
Folk dancing	35	27.7	9	25.0		28.9	6	17.6	9	50.
Apparatus	35	27.7	5	13.9		26.3	-	50.0	3	16.
	34	27.0	4	11.1		28.9		35.2	7	38.
Swimming and diving	22	17.5	2	5.5		10.5		41.2	2	11.
Life saving	20	15.9	1	2.8		7.9		41.2	2	11.

TABLE 2
Number and Percentage of the 126 Schools That Now Offer the Various Activities to High School Girls

		1118	i Sim	ou Guris						
	All S	chools		Schools ler 200		Schools 0-699		Schools ve 700		or High hools
Activities	N =126		N = 36		N = 37		N = 35		N = 18	
	No.	%	No.	%	No.	%	No.	%	No.	%
Basketball	125	99.2	35	100	38	100	35	100	17	94.4
Softball	124	98.4	34	97.1	38	100	34	97.1	18	100
Volleyball	119	94.4	31	88.5	38	100	32	91.4		100
Conditioning	107	84.9	30	85.7	32	84.4	32	91.4	13	72.2
Group games and relays	100	79.3	29	82.8	30	78.9	25	71.4	16	88.8
Tumbling, stunts, pyramids.	95	75.3	24	68.5	27	71.0	28	80.0	16	88.
Folk dancing	93	73.8	21	60.0	25	65.7	31	88.5	16	88.
Social dancing	88	69.8	18	51.4	27	71.0	26	74.3	17	94.4
Soccer	77	61.1	15	42.8	28	73.6	21	60.0	13	72.
Badminton	77	61.1	17	48.5	24	63.1	26	74.3	10	55
Table tennis	69	54.7	17	48.5	17	47.3	23	65.7	12	66.
Speedball	56	44.0	12	34.2	19	50.0	20	57.1	5	27.
Archery	47	37.2	14	40.0	19	50.0	16	45.7	0	0
Modern dancing	47	37.2	4	11.4	18	49.1	18	51.4	7	38.
Tennis	36	28.5	9	25.7	9	23.6	12	34.2	6	33.
Testing	36	28.5	5	14.2	13	34.4	13	37.1	5	27.
Square dancing	35	27.7	5	14.2	12	31.5	14	40.0	4	22.
Field hockey	34	26.9	6	17.1	14	36.8	12	34.2	2	11.
Bowling	26	20.6	4	11.4	8	21.0	10	28.5	4	22.:
Swimming and diving	24	19.0	2	5.7	4	10.5	16	45.7	2	11.
Golf	13	10.3	1	2.8	1	2.6	9	25.7	2	11.

TABLE 3

Percentage of High Schools Now Offering the Various Activities At the Several Grade Levels—Boys

(Percentage of those Responding)

Activities		9th			10th			11th			12th	
The cavitaces	S*	M*	L*	S	M	L	S	M	L	S	M	L
Basketball	100	97	90	100	100	88	97	100	88	97	100	85
Volleyball	100	81	86	100	95	82	97	95	79	97	97	76
Conditioning	94	97	86	94	97	85	89	97	85	86	95	88
Softball	86	84	86	83	89	88	80	89	88	80	89	85
Touch football	78	84	65	78	92	68	75	92	64	75	89	64
Track and field	78	84	79	78	81	73	78	81	64	78	79	56
Group games and relays.	67	92	79	64	89	73	61	81	64	61	79	62
Tumbling, stunts, pyra-												
mids	61	74	69	61	71	76	55	71	64	55	68	59
Soccer	58	60	38	61	63	38	58	53	35	58	53	32
Table tennis	47	50	14	47	50	23	44	52	23	44	55	23
Boxing	39	31	31	42	31	32	33	31	29	33	34	29
Badminton	39	34	10	39	34	18	36	34	18	36	34	20
Testing	36	50	55	36	50	59	36	50	56	36	47	53
Wrestling	36	42	52	36	45	68	36	45	64	36	42	53
Social dancing	22	34	17	28	31	18	19	29	18	19	29	20
Speedball	25	39	24	25	37	23	25	45	26	25	39	23
Folk dancing	25	29	3	25	29	9	20	26	15	17	8	12
Apparatus	17	16	45	17	18	44	14	24	38	14	24	44
Tennis	5	21	24	8	21	26	11	29	29	11	26	32
Swimming and diving	5	8	17	5	10	29	3	10	26	3	10	26

^{*}S = small high schools; M = medium-sized high schools; L = large high schools.

TABLE 4

Percentage of High Schools Now Offering the Various Activities At the Several
Grade Levels—Girls

(Percentage of those Responding)

Activities		9th			10th			11th			12th	
Retivities	S*	M*	L.	S	M	L	S	M	L	S	M	L
Basketball	97	100	90	97	100	89	94	100	94	94	100	91
Softball	94	100	74	94	100	91	89	100	86	89	100	71
Volleyball	91	92	71	91	92	86	89	92	74	89	92	71
Conditioning	78	84	71	80	84	74	78	81	69	78	81	66
Group games and relays	81	81	57	81	76	63	78	73	17	77	73	45
Tumbling, stunts, pyra-												
mids	58	73	63	58	70	63	58	62	54	56	62	51
Folk dancing	61	61	69	58	58	71	58	58	60	58	58	57
Social dancing	44	76	54	47	70	60	44	73	40	42	73	45
Badminton	33	41	40	33	43	51	44	57	57	44	59	69
Table tennis	31	43	45	33	46	49	33	43	57	36	43	60
Soccer	42	73	54	42	70	51	36	68	43	36	68	40
Archery	33	35	20	33	35	26	39	46	40	39	49	40
Speedball	33	38	31	36	41	37	33	41	45	33	41	37
Tennis	19	22	11	19	22	14	28	29	29	28	29	29
Field hockey	11	35	14	11	35	17	14	38	26	17	38	31
Testing	14	35	29	14	35	34	14	32	34	14	32	34
Square dancing	14	32	34	14	32	31	14	35	34	14	35	29
Modern dancing	14	35	31	11	38	37	11	50	37	11	43	34
Bowling	6	16	20	0	16	23	6	19	26	6	19	29
Swimming and diving	3	8	17	3	8	37	6	5	34	3	8	34

^{*}S = small high schools; M = medium-sized high schools; L = large high schools.

TABLE 5

Percentage of Eligible Men Physical Education Department Heads Reporting That They Would Like to Add Various Activities to Their Program (Percentage of Those Eligible Who Responded)

Activities		9th			10th			11th			12th	
and vittes	S*	M*	L.	S	M	L	S	M	L	S	M	L
Bowling	54	34	25	39	35	28	34	34	39	34	44	0
Tennis		53	41	57	53	55	62	62	58	62	61	68
Apparatus		44	44	60	55	47	61	61	47	58	59	58
Badminton	50	40	38	50	40	46	48	48	50	48	52	55
Testing	50	26	23	35	26	28	26	26	27	26	20	25
Golf	44	28	26	50	31	30	50	50	41	48	57	50
Tumbling, stunts, and pyra-												
mids		50	53	55	50	50	44	44	33	41	42	28
Social dancing	42	34	25	46	35	36	45	45	43	34	48	41
Boxing	36	4	5	38	8	4	37	37	21	37	12	21
Table tennis	36	37	40	37	31	38	35	35	0	35	57	0
Swimming and diving	35	43	54	38	50	58	40	40	64	40	44	60
Wrestling	35	60	21	35	76	45	39	39	45	39	54	45
Archery	30	18	29	30	13	32	29	29	48	26	27	53
Folk dancing	25	26	18	28	36	26	20	20	31	19	34	27
Modern dancing	25	18	7	29	17	9	23	28	15	20	14	15
Winter sports	20	3	21	20	3	26	17	17	29	17	3	29
Life saving	17	19	31	14	19	34	17	17	42	17	28	39
Soccer		13	39	9	21	43	0	0	45	0	11	36

^{*}S = small high schools; M = medium-sized high schools; L = large high schools.

TABLE 6

Percentage of Eligible Women Physical Education Department Heads Reporting That They Would Like to Add Various Activities to Their Programs

(Percentage of Those Eligible Who Responded)

Activities		9th		10th			11th			12th		
	S*	M*	L.	S	M	L	S	M	L	S	M	L
Folk dancing	85	60	35	67	56	60	53	50	29	53	50	27
Tennis	59	65	39	59	65	57	63	89	80	63	89	76
Archery	50	54	29	50	50	42	50	75	57	55	79	57
Social dancing	47	82	50	47	82	57	48	80	52	48	80	58
Tumbling, stunts, and pyra-												
mids	43	40	38	40	36	46	40	29	13	38	29	6
Bowling	42	35	32	42	39	41	47	47	54	47	47	56
Badminton	38	64	43	38	71	59	45	88	67	45	87	73
Table tennis	38	29	21	43	30	22	42	24	40	43	64	43
Swimming and diving	29	38	69	29	38	87	32	34	74	31	35	74
Modern dancing	27	42	25	28	48	32	38	45	65	41	48	48
Track and field	25	27	16	21	24	16	24	17	16	24	19	16
Field hockey	22	63	30	22	71	31	26	74	42	27	65	42
Apparatus	21	24	10	21	26	23	24	18	20	24	18	13
Soccer	19	20	25	19	18	24	13	17	20	13	17	29
Golf	12	32	25	14	35	47	26	57	55	26	64	56
Life saving	12	19	26	14	19	34	11	26	50	11	29	66
Speedball	4	17	17	4	18	32	4	27	26	4	27	18

^{*}S = small high schools; M = medium-siz d high schools; L = large high schools.

Results and Discussion

PRESENT PREVALENCE OF ACTIVITIES

A high degree of uniformity among the nine most popular activities for both boys and girls is indicated by the fact that seven activities are reported among the nine most frequently listed for both sexes in all schools and in all grades. These activities are: (1) basketball, (2) volleyball, (3) conditioning activities such as calisthenics, workouts, etc., (4) softball, (5) games and relays, (6)

tumbling, stunts, and pyramids, (7) soccer.

There is a marked tendency for high schools under 700 and for junior high schools to offer all activities included in their programs at all grade levels. This may be because those in charge believe that an activity worth offering is worth repeating in all grades; it may be due to poor policies of assigning students to classes; it may be due to existing facilities or lack of them; student interest may account for it; and limited competencies of personnel may be a factor. At any rate, the tendency is considerably less marked in high schools above 700 than it is in other schools.

Activities listed in order of frequency below the nine most prevalent also show considerable uniformity although the trend is less marked than it is among the nine most popular. Boy's programs rank boxing, wrestling, and apparatus quite high while many girls' programs include archery, modern dance and table tennis. Swimming and diving, testing, apparatus, wrestling, bowling, and golf are found with considerably more frequency in the large

high schools (700 and above) than in the smaller schools.

Tables 1 and 2 show the number and percentages of the 126 schools that now offer the various activities as well as the offerings of the schools according to the several classifications. Tables 3 and 4 show the percentages of high schools in the several classifications that now offer the various activities at each of the

several grade levels.2

Jackson,³ in a study reported in 1942, presented information concerning activities included in boys' and girls' physical education programs in Illinois secondary schools. Monroe,⁴ in a 1926 study which was national in scope, reported activities included in programs for boys based upon information provided by men teachers in 47 states. Chart I compares the prevalence of activities as shown by this study with prevalence shown by the Jackson and Monroe studies.

The chart is limited to those activities which were reported by 25 percent, or more, of the schools in any one of the studies. The first 19 activities in Chart I are listed in rank order of boys' activities as shown by the present study.

³ Chester O. Jackson. "Activities Engaged in by Teachers of Physical Education in the High Schools of Illinois," Research Quarterly. 13: 242-251 (May 1942).

² Included in Tables 1-7 are only those activities which were checked by 25 or more percent of the high schools included in at least one classification. The entire list of activities and the junior high school data are given in Practices and Opinions in Physical Education, Health and Safety.

⁴ W. S. Monroe. The Duties of Men Engaged as Physical Directors or Athletic Coaches in High Schools. University of Illinois Bulletin No. 38, 1926.

Rank order of girls' activities as shown by the present study, as well as rank order in the Jackson and Monroe studies is indicated in parentheses after the percents of schools reporting the several activities. A total of 38 activities are listed in this study; Jackson lists 52, and Monroe lists 28. Although the lists are not identical, there is sufficient similarity to provide considerable comparison.

WHAT ACTIVITIES NOT NOW OFFERED DO PHYSICAL EDUCATION DEPARTMENT HEADS BELIEVE SHOULD BE OFFERED IF TIME, PERSONNEL, AND FACILITIES PERMITTED?

The individual and dual sports of tennis, golf, archery, badminton, and bowling rank high among activities which men and women department heads would like to see added to programs not now offering these activities. Also ranking high are apparatus, swimming and diving, social dancing, and folk dancing.

It is quite apparent that the men and women responsible for the programs believe that more activities should be sponsored. However, the inference that the respondents believe that more activities should be offered within the framework of their present limitations in time, facilities and personnel are not justified by the data. There is a dominant opinion favoring adding a substantial number of activities in order to provide more adequate services, but probably only if and when circumstances are such that a more comprehensive program is feasible.

Tables 5 and 6 deal with activities which 25 or more percent of high school department heads would like to add. Percents and grade levels are shown. Attention is called to the fact that schools now sponsoring a given activity are not eligible to say that they would like to add that activity to their programs. Percentages are calculated on the basis of the number of schools eligible for the response. For instance, 9 of the 34 high schools above 700 now offer swimming and diving for boys at the twelfth grade and 25 of them do not. Fifteen of the 25, or 60 percent, would like to add this sport.

TO WHICH ACTIVITIES WOULD DEPARTMENT HEADS LIKE TO ALLOT MORE TIME?
TO WHICH WOULD THEY LIKE TO ALLOT LESS TIME?

Above, it was shown that a substantial number of men and women department heads would like to add to their programs a substantial number of activities not now included in the programs of their schools. Responses to the question "To which activities would you like to allot more time than they now are given?," show that 28 different activities fall into this catagory. The three activities mentioned the greatest number of times by men are conditioning (such as calisthenics and workouts), tumbling, stunts, and pyramids, and testing. The three activities mentioned the greatest number of times by women are social dancing, badminton, and folk dancing.

Not many of the respondents wish to devote less time than now is alloted to any one of the activities. Basketball and softball are the only activities to

Activity	Present Study Percent of Total	Jackson Study Percent of Total	Monroe Study Percent of Tota
1. Basketball.	97	88 (1)1	60 (2)1
2. Volleyball	94	74 (3)	53 (7)
3. Conditioning (calisthenics, workouts, etc.).	94	69 (4)2	70 (1)
4. Softball	90	77 (2)	37 (14)
5. Touch football	82	63 (6)	40 (12)
6. Track and field	81	61 (8)	55 (6)
7. Games and relays	81	$61 (7)^3$	60 (3)2
8. Tumbling, stunts, and pyramids	72	54 (11)4	42 (11)8
9. Soccer		39 (14)	25 (18)
0. Testing	50	Omitted	Omitted
1. Wrestling		37 (18)	17 (19)
2. Table tennis	42	37 (17)	Omitted
3. Boxing		38 (16)	16 (21)
4. Badminton	33	30 (22)	Omitted
5. Speedball	32	Omitted	Omitted
6. Social dancing	32	17 (30)	Omitted
7. Folk dancing	28	11 (34)	7 (26)
8. Apparatus		25 (24)	44 (9)
9. Tennis	27	29 (23)	17 (20)
0. Baseball	Omitted	66 (5)	43 (10)
1. Floor-mat stunts	Omitted	57 (9)	Omitted
2. Individual athletics	Omitted	43 (12)	48 (8)
3. Marching	Omitted	40 (13)	56 (5)
4. Combatative contests	Omitted	39 (15)	34 (16)
5. Horseshoes	Omitted	31 (20)	Omitted
6. Correctives	Omitted	Omitted	39 (13)
7. Exercises with hand apparatus	Omitted	7 (38)	35 (15)

1 Numbers in parentheses indicate rank order.

² These percentages represent prevalence of calisthenics; a more limiting classification than the present study uses

³ The Jackson and Monroe studies listed games and relays separately These percentages represent the highest response in either.

⁴ The Jackson study listed tumbling, stunts, and pyramids separately. This percentage indicates the highest response in any one of the three.

CHART II

A Comparison of Prevalence of Girls' Activities Between the Present Study and Jackson's Study

Activity	Present Study Percent of Total	Jackson Study Percent of Tota
1. Basketball	99	83 (2)1
2. Softball	98	68 (6)
3. Volleyball	94	86 (1)
4. Conditioning (calisthenics, workouts, etc.)	85	71 (4)2
5. Games and relays.	79	80 (3)3
5. Games and relays. 6. Tumbling, stunts, pyramids.	75	52 (11)4
7. Folk dancing	74	62 '(7)
8. Social dancing		43 (14)
9. Soccer		43 (15)
0. Badminton	61	38 (17)
11. Table tennis	55	46 (12)
2. Speedball	44	Omitted
13. Archery		21 (26)
14. Modern dancing.	37	27 (22)
15. Tennis	28	39 (16)
6. Testing.	28	Omitted
17. Square dancing		Omitted
18. Field hockey	27	15 (32)
9. Marching.	Omitted	59 (9)
20. Baseball	Omitted	58 (10)
21. Shuffleboard	Omitted	36 (19)
22. Deck tennis.	Omitted	32 (20)

which more than 10 percent of the department heads would like to allot less time, and that expression of opinion seems largely offset by the fact that the number of men and women who would like more time for these sports is about equal to the number who would like to devote less time to them.

It is apparent that department heads feel that they need more time in order to provide optimum services for students. This is demonstrated by the many men and women who would like to add activities not now sponsored, by the substantial number desiring more time for present activities, and by the few who are willing to cut down the time devoted to activities presently sponsored.

More time implies more facilities, more equipment, and more teaching personnel. The unmistakable fact is that physical education department heads overwhelmingly believe that more time, facilities, and teaching personnel are needed for adequate programs. National and state organizations as well as "experts" in the field agree.

TABLE 7

Percentage of Eligible Men and Women High School Department Heads Reporting They Would Like to Spend More Time on Various Activities in Their Program

(Percentage of Those Eligible Who Responded)

		Men		Women			
Activities	Under 200	200-699	Above 700	Under 200	200-699	Above 700	
Apparatus	50	44	60	33	0	40	
Social dancing.	46	18	28	35	46	52	
Testing	38	28	50	40	31	50	
Folk dancing	37	50	0	36	35	16	
Badminton	36	38	28	31	55	42	
Tumbling, stunts, and pyramids	36	38	50	24	26	23	
Conditioning	26	25	18	7	23	27	
Table tennis	12	74	0	38	18	33	
Archery	0	40	25	36	50	43	

Table 7 deals with activities to which a substantial number of department heads would like to devote more time. Percentages and grade level are shown. In interpreting the table, it should be remembered that not all department heads are eligible to respond that they would like more time for a given activity. Only schools now sponsoring a given activity can express a desire for a change in the time alloted. Percentages are calculated on the basis of the number eligible, not on the basis of the total number of schools participating in the study.

VARIETY OF ACTIVITIES

The Health and Physical Education Department of the Illinois Office of Public Instruction in a pamphlet, Standards to be Observed in Setting Up a Program in Physical Education for High Schools, has stated: "The curriculum must cover a minimum of twenty activities . . ." The same pamphlet indicates that at least four of the 20 activities should be of the individual and dual type.

Because of some variation in classification of activities the Illinois Office of Public Instruction might not agree with the results of this study in judging whether or not schools meet the stated standards. However, it is apparent that there must be much greater variety if the 20-activity standard is to be substantially met and that considerable increase in individual and dual activities is required if that standard is to be met.

On the basis of the classification of activities used in this study, only 3 percent of the high schools participating now meet the 20-activity standard for boys and only 5 percent of the programs for girls meet this standard. Forty percent of the boys' department heads and 33 percent of the girls' department heads would like to meet the standard of 20 activities. Not only practice, but also teacher opinion concerning desirability seems out of agreement with the

20-activity standard.

The standard of at least four activities of the individual and dual type finds much greater acceptance than does the 20 activity standard. A substantial percent of schools now include four or more individual and dual activities and an overwhelming majority of department heads would like to do so. Forty-one percent of the boys' programs and 33 percent of the girls' programs now meet the individual and dual type activity standard; 89 percent of the department heads would like to meet this standard for boys and 80 percent would like to do so for girls.

It should be noted that neither compliance nor agreement with the standards is derived from answers to direct questions concerning the Office of Public Instruction Standards. Rather, they are derived from information regarding activities now included and those that department heads believe should be

included. The standards were not mentioned in the inventories.

Table 8 shows the variety of activities, existing and desired, in the several classifications of schools in terms of range and quartiles. Examination of the table shows that schools of less than 200 enrollment meet the standards, and desire to meet them, less frequently than do the larger schools. Although the numbers are shown as quartiles, they should be interpreted as quartile ranks, i.e., 25 percent of the schools lie below Q1, etc.

Summary

Boys' programs in 75 percent, or more, of the participating schools include (1) basketball, (2) volleyball, (3) conditioning (calisthenics, workouts, etc.), (4) softball, (5) touch football, (6) track and field, and (7) games and relays. Fifty percent, or more, boys' programs also sponsor tumbling, stunts, and pyramids, soccer and testing. Girls' programs in 75 percent, or more of the schools include (1) basketball, (2) softball, (3) volleyball, (4) conditioning (calisthenics, workouts, etc.), (5) games and relays, and (6) tumbling, stunts and pyramids. Fifty percent, or more of girls' programs also include folk dancing, social dancing, soccer, badminton, and table tennis.

A high degree of uniformity among the nine activities most frequently included for both boys and girls at all grade levels by schools of all sizes is indicated

TABLE 8

Number of Activities, Existing and Desired, in the High School Programs for Boys and Girls

High School Classification	N		Total N	Number of A	ctivities	
righ School Classification	14	Lowest	Q1	Median	Q3	Highest
A. T	otal Nu	mber of A	ctivities			
Under 200		1		1		
Existing						
Boys	36	5	9.1	10.5	13.5	16
Girls	35	4	7.2	10.0	12.3	20
Desired						
Boys	36	7	14.5	18.5	20.5	24
Girls	35	7	11.1	15.0	18.6	26
200-699	00		11.1	10.0	10.0	
Existing				- 1		
Boys	38	7	10.2	12.3	14.3	22
Girls.	38	8	9.8	12.3	14.9	21
Desired	00		2.0	12.0	11.7	-1
Boys	38	10	15.8	18.7	22.3	26
Girls	38	10	15.3	17.3	20.9	24
700 and above	30	10	13.3	17.3	20.7	44
Existing						
Boys	34	5	10.1	12.5	16.5	19
Girls	35	7	11.9	14.1	17.0	24
Desired	33	'	11.9	14.1	17.0	24
Boys	34	11	16.8	19.3	21.0	26
Girls	35	10	16.7	19.0	22.1	27
Ollis	33	10	10.7	19.0	22.1	21
B. Number	of Indiv	idual and	Dual Acti	ivities		
Under 200				1 1		
Existing						
Boys	36	1	1.9	2.8	3.9	6
Girls	35	0	1.0	2.1	3.1	9
Desired						
Boys	36	1	4.3	5.9	7.5	9
Girls	35	0	2.8	4.4	6.3	9
200-699						
Existing						
Boys	38	1	2.3	3.4	4.2	9
Girls	38	0	1.0	2.2	3.3	5
Desired						
Boys	38	1	5.0	6.2	7.6	10
Girls	38	2	4.0	5.0	6.1	8
700 and above						
Existing						
Boys	34	1	2.2	3.2	5.2	8
		0		3.1	4.8	8
Girls	35	0	2.1	3.1	4.0	1 0
	35	0	2.1	3.1	4.0	0
Girls	35 34	2	5.6	6.6	7.9	9

by the fact that seven activities are reported among the nine most frequently listed for both sexes in all schools and in all grades. High schools above 700 vary their activities from grade to grade considerably more than do the smaller high schools or the junior high schools.

Activities that have gained markedly in popularity in recent years, as shown by comparisons with the Jackson and Monroe studies, include volleyball, softball, touch football, speedball, social dancing and folk dancing. Progress has been made in offering more students opportunities to participate in similar activities. This study shows that 75 percent, or more, of the boys' programs include seven common activities while 75 percent, or more, of the girls' programs include six common activities. Jackson's Illinois study (1942) shows only two activities for boys, and three for girls, common to as many as 75 percent of the schools, and Monroe's study (1926) national, in scope and dealing only with boys' programs, found no activity common to more than 70 percent of the schools.

Department heads believe that more time is needed for physical education. This is indicated by the many men and women who would like to add activities not now sponsored, by the substantial number desiring more time for present activities, and by the very few who believe it desirable to lessen the time now devoted to any activity with the possible exceptions of basketball and softball.

It is apparent that the men and women responsible for programs believe that more activities should be sponsored. Many would like to add the individual and dual sports of tennis, golf, archery, badminton, and bowling to their present programs. Also, a substantial percentage would like to add apparatus, swimming and diving, social dancing, and folk dancing. However, the inference that department heads believe that more activities should be offered within the framework of their present limitations in time, facilities, and personnel must not be drawn.

It appears that less than 10 percent of the schools participating in this study now meet the standard of a minimum of 20 activities suggested by the Illinois Office of Public Instruction. Further, there is evidence to indicate that less than 50 percent of the department heads believe that the standard should be met. Caution in this interpretation is necessary, however, because of variation in the classification of activities.

Breath-Holding as a Measure of Physical Fitness

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B REATH-HOLDING capacity, or voluntary apnea, as it is sometimes called, has long been of interest to physiologists, medical practitioners and physical educators. During the past century there have been numerous attempts to explain the physiology of breath-holding. These studies have covered such matters as the exchange of gases in the lungs during breath-holding, the effects of hyperventilation and O₂ inhalation on breath-holding time, and the interrelation of barometric pressure and breath-holding ability. In these physiological investigations, the experimental method with relatively few subjects was frequently utilized.

Breath-holding ability has also been employed as a clinical test. Since about 1900, various members of the medical profession have employed the test in diagnosis and prognosis. Until recently, these studies have been, for the most part, the observations or case studies of general practitioners instead of scientifically controlled experiments. The work of the medical departments of the New England Mutual Life and Prudential insurance companies, through their use of breath-holding tests in selecting good insurance risks, stimulated con-

siderable interest and research.

During the past fifty years, there have likewise been many attempts to validate the use of breath-holding as a means of appraising one or more areas of fitness in normal, healthy subjects. Probably the first investigations were begun as a result of interest in measuring altitude tolerance in connection with mountain sickness. Later, with consideration being given to aviation fitness during World War I, altitude tolerance again became important. This gave impetus to several noteworthy studies of breath-holding ability. Since World War I, research workers in physical education and athletics have continued the work

It is the purpose of this paper to assemble and evaluate the results of these researches and glean from them the conclusions which appear to have adequate supporting evidence.

Physiological Studies of Breath-Holding

Alveolar Gas Exchange During Breath-Holding. According to Wardlaw (165), alterations in the composition of alveolar air during breath-holding were studied as early as 1855 by Beecher. He held his breath for various periods up to 100 seconds and measured the CO₂ in the expired air. The tension of CO₂ was found

to rise at a continuously decreasing rate and approached a constant value for long breath-holding periods. Beecher's results were confirmed in experiments with animals (109, 165) and with human subjects (66, 82, 105, 165). Furthermore, alveolar O₂ tension has been shown to decrease at a continually decreasing rate (4, 105, 165). The decrease in O₂ tension is more rapid than the increase in CO₂ tension (39, 82, 165), the ratio being greater than three to one, according to one author (165). The progressive decrease in lung volume during breath-holding which has been observed in pneumograph tracings (63) is, in all probability, associated with the different diffusion rates of O₂ and CO₂. A decrease in lung volume has also been demonstrated by other workers who measured the volume of expired air after breath-holding periods of various durations (161). As a result of the difference in diffusion rates of O₂ and CO₂, a progressive increase in body density occurs during breath-holding (161). Apparently the CO₂ which is not transferred to the lungs accumulates in the blood or tissues, since only about one percent of the total is given off in the urine (161).

Respiratory movements and simple changes in intrathoracic pressure during breath-holding evidently increase the rate of gas exchange in the lungs (105, 165). This was verified by rebreathing experiments in which terminal CO₂ tensions were higher and O₂ tensions lower than in simple breath-holding (29, 82, 165). The advantages to be had from simulated respiratory movements during under-water swimming and other activities in which maximum breath-holding is important can thus readily be appreciated. With most subjects, involuntary respiratory movements begin sometime before the termination of breath-holding and can be recorded by means of a pneumograph (63, 136).

In 1936, Lux (110) correlated terminal alveolar O₂ and CO₂ tensions with breath-holding times. He concluded that CO₂ accumulation was responsible for the "breaking-point" in breath-holding, although there is little evidence in the coefficients reported which justifies such a conclusion. Ten years later the analysis was carried one step further by employing partial correlation (78). Here, again, it was concluded that CO₂ accumulation and not O₂ depletion was

the significant factor in determining breath-holding time.

Effects of Hyperventilation and Oxygen Inhalation on Breath-Holding Ability. The effect of increasing breath-holding time by preliminary forced breathing was noted by Vernon (164) in 1909, and more recently by others (33; 51; 52, p. 117; 53; 65; 82; 85; 152; 156). This effect has generally been attributed to the washing out of the CO₂. The oxygen in the alveoli falls to a much lower percentage during breath-holding when preceded by hyperventilation. The result is a three or four-fold increase in the length of time the breath can be held. If the last few breaths contain a large percentage of oxygen, the breath-holding time is increased still more. Vernon (164) secured times up to 8 minutes 13 seconds, and Schneider (156) up to 15 minutes 13 seconds by this method.

Other workers have also observed this effect of increasing breath-holding times by oxygen inhalation (39, 53, 65, 82, 152). Oxygen inhalation before breath-holding increases the terminal O₂ and CO₂ percentages in the alveolar air (65, 164). Oxygen inhalation and hyperventilation each separately increase the amount of strenuous work that can be done while the breath is held (82,

83). In an uncontrolled study (84) the duration of breath-holding was increased about two and one-half times when the test was preceded by a hot bath. This was due, according to these writers, to the washing-out effect and oxygenation produced by heat dyspnoea. However, sufficient details of the experiment were lacking for an accurate evaluation of the research. The length of time the breath can be held has also been found to vary with the volume of air inspired (63, 66, 67).

Blood Changes During Breath-Holding. Apparently Meakins and Davies (128) were the first to demonstrate by arterial punctures that arterial anoxemia takes place during breath-holding. However, the most extensive work of this kind was done by Stevens and his colleagues at the College of Medicine, University of Cincinnati (34, 39, 161). These workers showed that CO₂ accumulated in the blood at the rate of about two volumes percent per minute for a circulating blood volume of five liters. The pH fell on the average from 7.38 to 7.30 and the oxygen saturation from approximately 96 to 85 percent. Arterial saturation remained about 100 percent when the breath-holding was preceded by oxygen inhalation.

Altitude and Breath-Holding Ability. The decrease in breath-holding capacity which occurs with an increase in altitude was reported by Mosso (137, p. 201) in 1898. In a typical case the duration of maximum breath-holding at sea level was twice as long as at an atlitude of 3,620 meters. Henderson (76, 77) noted that alveolar CO₂ before breath-holding (a measure of "alkali reserve") was also reduced with altitude. Observations of other investigators (129, 157, 163)

verified the work of Henderson.

As a result of breath-holding tests administered in a low-pressure chamber during World War II, a direct relationship was shown between breath-holding time and the partial pressure of oxygen in the air breathed before the test (14). Pressures corresponding to sea level, 18,000 feet and 30,000 feet were used.

These results were corroborated in more recent reports (34, 152).

Effect of Exercise Preceding Breath-Holding. Although breath-holding times are reduced with exercise preceding the test, terminal alveolar CO₂ reaches higher levels and the alveolar O₂ does not fall as low (82, 158). When breath-holding is preceded by short bursts of strenuous work, the duration of the voluntary apnea appeared to vary inversely with the intensity of work (footpounds of work in 15 seconds, (152). The effect of preceding moderate exercise on breath-holding time has not been established conclusively. One writer (106) concluded that breath-holding times are directly proportional to the "amount" of moderate exercise taken immediately before the test. In another study (134) increasing the duration of moderate exercise had progressively less effect in reducing breath-holding times. The latter conclusion appears to be more reasonable in the light of evidence available concerning exercise physiology.

Vitamin Intake and Breath-Holding Ability. The influence of vitamin B₁ on breath-holding was studied by McCormick (112) who gave vitamin B₁ daily to four subjects for a period of one week. Each of the subjects improved in breath-holding and the improvement was attributed to the vitamin feedings. Because of the small number of cases and the lack of controls in McCormick's

study, Karpovich and Millman (97) repeated the experiment using 20 subjects: 10 in the experimental group and 10 controls. There was no appreciable effect of vitamin B₁ on breath-holding ability. Harper and his associates (73) in a well-controlled study, reported appreciable gains in breath-holding due to vitamin supplements. Approximately half of his subjects (the experimental group) were given daily, one "Adexolin" capsule containing vitamin A, vitamin D and vitamin C. The remaining subjects (the control group) received placebos identical in taste and appearance to the vitamin capsules. After 10 weeks of such feedings the groups were rotated for another 10 weeks. Among the tests given before the feeding was begun, again at the time of rotation, and finally at the end of the second 10 weeks, were normal breath-holding after one deep breath and breath-holding against 40 mm, of Hg. The difference in improvement was statistically significant and in favor of the group receiving vitamins, both before and after rotation. Jenkins and Yudkin (91) repeated the study of Harper and associates with 178 children. After one year of daily diet supplementation with vitamin A, vitamin B₁, vitamin C and vitamin D, these investigators could find no beneficial effect on breath-holding ability which could be attributed to vitamin feeding.

Practice Effects of Breath-Holding. Authors of articles concerning breath-holding seldom fail to mention the marked improvement in breath-holding time which occurs by simply repeating the test. It has been demonstrated that not only longer breath-holding periods result through repetition after brief intervals, but also higher terminal alveolar CO₂ percentages are reached (82). This has been explained on the basis that after each period of breath-holding, greater-than-normal ventilation occurs and the blood is oxygenated to a greater extent. However, this can hardly be the case, since other investigators (134, 159) secured considerable improvement when the tests were repeated on different days. Furthermore, even without hyperventilation, the

arterial blood is between 96 and 100 percent saturated with oxygen.

Breath-Holding as a Clinical Test

Breath-Holding in Diagnosis. Poor breath-holding ability has frequently been identified as a clinical symptom of heart disease. In 1902 Sabrazes (153) reported a decrease in breath-holding ability associated with organic heart conditions. As a result of such evidence, Herz (81), over thirty years ago, recommended normal breath-holding (i.e., not preceded by exercise) as a heart function test and it is still being recommended by some authorities (169). The results of Sabrazes have been confirmed in a number of more recent studies (27, 28, 33, 79, 80, 138, 142, 143, 160). Brittingham and White (13), however, concluded that the influence of neurotic factors greatly limited the usefulness of breath-holding for diagnosing heart conditions.

Hermann (79, 80) used normal breath-holding time after inspiration divided by normal breath-holding after expiration to form a "respiratory ratio." He suggests that ratios less than 40/25 or greater than 70/35, in seconds, are indicative of cardio-respiratory inefficiency. The ratio has been used by others (8, 19, 33) and is sometimes referred to as "Bartlett's Index." From an inspec-

tion of the data contained in these reports, the respiratory ratio does not appear to have any advantage over simple breath-holding in diagnosing heart conditions.

In addition to quiet breath-holding tests, successful diagnosis of heart disorders have been achieved through the use of breath-holding preceded by exercise (142, 143). The depth and frequency of respiration immediately after breath-holding has also been investigated (27, 28). Cardiac patients, despite their shorter breath-holding times, experienced greater gain in depth and frequency. Dyspnoea, of course, has long been recognized as a symptom of the cardiac patient. The Frost test (54) was modified by Eustis (35, 36, 37, 38) and also by Bethea (9) and employed in diagnosing organic heart conditions. These authors found the test useful as a clinical tool.

There appears to be little doubt that breath-holding ability is much reduced in at least certain types of cardiac disorders. However, the explanation for this phenomenon is not given in the studies reported and it is this explanation which would be of considerable value in interpreting the worth of breath-holding as a physical fitness test in healthy subjects. A number of factors may contribute to the reduction of breath-holding times in heart cases, as for example: weak cardiac structure, disturbance of acid-base balance (retention of acids), inadequate delivery of oxygen, psychological causes, etc. Apparently the experimental work on this point has not been done.

Breath-holding capacity in patients with lung disorders have also been investigated by numerous clinicians and research workers. Although one author (153) reported no decrease in breath-holding time in cases of advanced pulmonary tuberculosis, the evidence is quite conclusive that a marked reduction, in general, does occur (10, 68). In a very thorough study by Wittich and Polczak (173), breath-holding both after inspiration and after expiration was found to decrease along with vital capacity as the severity of pulmonary tuberculosis increased. These results agree with those of Natali (138).

Lowered breath-holding scores were also observed in cases of chronic bronchitis and emphysema of the lungs (160). Soldiers suffering from gas suffocation during World War I were reported to have poor breath-holding ability (10). Moncrieff (131, 132) reported subnormal breath-holding scores in both of the Flack tests (49) among patients hospitalized because of lung disorders, but also found scores on one of the Flack tests to be very poor among patients hospitalized for reasons other than cardiovascular or respiratory conditions (133). Henry (78) gave breath-holding tests after exercise to subjects having a common cold. Three weeks later the subjects were retested and showed a significant improvement. He hypothesized that a concomitant reduction in alkaline re-

In an early paper (19) small respiratory ratios were reported among cases in which there was paresis, paralysis of muscles of inspiration, pathological lung conditions which obstruct pulmonary circulation, and in pericardial adhesions which prevent normal movement of the lungs and heart. A decrease in breath-holding ability and a decrease in respiratory ratio were also found in cases of nephritis (33, 142, 143) and hypertension (33). Hypertension has also

serve associated with the infection was responsible for the poorer times.

been successfully diagnosed by observing changes in blood pressure during breath-holding (6, 69). Jaundice patients have also been found to have poor breath-holding ability (70).

Low respiratory ratios were observed in patients with thyrotoxicosis (8). In this study it was found that the alkali reserve did not vary with the course of the disease and, hence, with the value of the respiratory ratio. Low respiratory ratios were also reported by Eisennschimmel-Eisen (33) in fourteen cases of hyperthyroidism. Sainton and Schulmann (154) believed breath-holding ability varied with the activity of the thyroid gland and, hence with the meta-

bolic rate, but the data are lacking to substantiate this hypothesis.

A number of workers have found poor breath-holding ability in mental patients (30, 130, 170). Neurocirculatory asthenia patients have also been observed by Drury (31) and Wood (174, 175) to have poor breath-holding times. Wood also made the interesting observation that 45 minutes of hyperventilation did not appreciably affect the breath-holding times of his neurocirculatory asthenia patients. This was attributed to abnormal emotional stimulation of the respiratory center in these cases. Friedman (53) continued the work of Wood but, in addition, noted that preliminary oxygen inhalation did not affect the breath-holding times of such patients. No differences in CO₂ combining power of the blood plasma (alkali reserve) was observed between his patients and "normals". Friedman (52) later developed a "Hyperventilation Index" for diagnosing cases of functional cardiovascular disease. This was simply the ratio of breath-holding time preceded by hyperventilation (45 breaths in 45 seconds) divided by breath-holding time after one inspiration.

There appears to be ample evidence that breath-holding ability is materially reduced in patients with infectious conditions. This is probably due to the disturbance of the acid-base balance, but the experimental proof is lacking. Lung disorders also decrease breath-holding time, but whether this is due to mechanical obstructions and/or changes in permeability of the lung tissues or other factors, also has not been determined. It is conceivable that secondary changes

in the metabolic or cardiovascular system may be responsible.

Breath-Holding Capacity and Operative Risk. Stange (160) in 1914 stated that a patient who could not hold his breath for 20 seconds after one deep breath is a poor operative risk. He recommended local anesthesia in such cases or, if the operation is not urgent, the general condition of the patient should first be improved. Breath-holding ability, considered along with other tests, was found to be an indication of the patient's capacity to undergo general anesthesia in dental treatment (93). Fitz-Patrick (40) used breath-holding after one deep inspiration in diagnosing toxemia occurring during pregnancy. After administering the test to 871 obstetrical cases, he concluded that poor breath-holding time generally indicated a poor obstetrical risk. The changes in blood pressure during 30 seconds of breath-holding have been suggested as a measure of adrenalin reserve, and hence, the ability of a patient to withstand surgery (125, 126).

Breath-Holding and Life Expectancy. Frost (54) of the Medical Department, New England Mutual Life Insurance Company, appears to have been the first

to utilize breath-holding in the selection of good life insurance risks, although this possibility had been suggested earlier by Fisk (32). Frost originally used maximum breath-holding after full inspiration and full expiration together with fluctuations in pulse rate and systolic blood pressure while the breath was held for 10 seconds against a pound of positive pressure. His test was later altered somewhat and more emphasis was placed upon the fluctuations in systolic pressure during short periods of breath-holding. In this latter form the test was known as the "Cardio-Respiratory Test" (58, 59, 61). Normal standards were presented by Frost and Amiral (62) based on 1.500 subjects. Using the test results of 3,500 applicants for life insurance, the mortality for the group which passed the test was only 25.29 percent by the American Experience Table and 48.20 percent by the American Men Select Table (60). Later reports (55, 56, 57) based on still larger numbers confirmed the usefulness of the test in selecting good risks. Amiral (2, 3) used the same procedure as Frost, but observed the changes in diastolic pressure instead of systolic pressure. This test appeared to have merit, but was less efficient in discovering poor risks.

In 1929 MacKenzie and other members of the medical department of the Prudential Insurance Company of America published the first report of their test (123) which was quite similar to that of Frost. The flarimeter (168) was developed by them in connection with this work. A complete description of the instrument and test procedure appears in the reference just quoted, in a pamphlet published by the Prudential Insurance Company (26), and also in an article by Wells (167). MacKenzie and his associates placed much more emphasis upon the duration of breath-holding (i.e., exhalation through the small orifice) than did Frost. Reports of the validity of the test for selecting good insurance risks have been published (120, 121, 124). The test reactions of 22 athletes fell within the normal range (122).

Since these articles by MacKenzie and his associates, no further report of either the Frost or flarimeter test has appeared in the Abstract of Proceedings of the Association of Life Insurance Medical Directors of America. However, from personal correspondence the present writer has learned that the flarimeter test is still being used by at least certain Prudential examiners.

Breath-Holding as a Test of Physical Fitness in Healthy Subjects

Breath-Holding Ability and Aviation Fitness. Mosso (137, p. 201), having noticed the decrease in breath-holding capacity which occurred at high altitudes, reasoned that the ability to hold the breath should correlate with resistance to mountain sickness. However, he found no correlation between breath-holding ability and altitude tolerance in 15 medical students. He also made the interesting observation that one of a family of swimming birds, the diver, although it can stay submerged for from 5 to 6 minutes, does not have a greater proportion of blood or lung development than other animals. Also, when the diver was placed in a bell and the pressure reduced, it resisted rarified atmosphere much less than many other animals.

Nevertheless, in 1918, Flack (45, 151) included breath-holding in a battery of tests for selecting pilots. He believed that the "power" to hold the breath

is closely related to the capacity of the candidate to bear the strain of high altitude. He used maximum breath-holding with the subject maintaining a positive intrathoracic pressure of 20 mm. Hg. In his "fatigue" breath-holding test the pressure was 40 mm. Hg. Pulse rates were taken every 5 seconds during the latter test. In addition to the breath-holding times and fluctuations in pulse rate, some importance was placed on the answer the subject offered as to why

he could no longer hold his breath.

For the validity of the test, Flack depended on the power of the test to differentiate the fit pilots (instructors, home defense pilots, etc.) from the pilots taken off training due to stress (43, 47, 50). Breath-holding times appeared to be of most value. The pulse rate during the fatigue test was of little use in differentiating the groups except in extreme cases (49). Flack also found that poor breath-holding times correlated with a greater number of days permanently or temporarily unfit for duty for long periods during the first year of service in the air force (49). As a consequence of this, a normal breath-holding time of 45 seconds was recommended as a minimum for French air force candidates (123). Flack recommended boxing and underwater swimming as desirable activities during the candidates' training period. In a controlled study (50 cases) he showed that air cadets taking special exercises improved in breath-holding ability more than those in the regular program (44). He observed that experts in sports were able to hold their breath for long periods of time, and also made good high altitude fliers (45).

Birley (11) did not agree with Flack that his tests were tests of altitude tolerance. However, Birley found them useful in differentiating those pilots who could be returned to active duty after injury, from those who should be kept

in the hospital or retired to inactive duty.

Schneider (155) gave Flack's breath-holding tests to 45 aviation cadets and also had these same subjects rebreathe into a 52 liter bag as long as they were able, the CO₂ being absorbed continuously. He found no significant correlation between breath-holding ability and the tolerance to low oxygen tensions or between breath-holding and rate of O₂ consumption. In another investigation by Schneider (156) subjects breathed air through a circuit for a short time and then, without the subjects' knowledge, the air circuit was replaced by one containing pure nitrogen. The subjects were allowed to breathe nitrogen until unconsciousness was impending. He found no significant correlation between ability to hold the breath and duration of nitrogen breathing. Forty-five subjects took 200 tests in these experiments. From the results, Schneider concluded that good scores on Flack's test were more dependent on will power than physical fitness.

The work of Schneider in correlating the results of the rebreathing test with breath-holding ability was repeated with 87 subjects (5). In addition, 50 subjects held their breath after a standard exercise. No significant correlation was found between the rebreathing test and either the normal breath-holding or breath-holding after exercise. The writers concluded that Flack's tests "... require too much voluntary attention and hearty cooperation on the part of the

patient" (5, p. 88). Nevertheless, maximum breath-holding is still recommended as a test of fitness for flying (94). Although the test may have some value as a means of classification, it very likely does not measure altitude tolerance.

Flack and Burton (51) investigated the physiology of the fatigue test. They considered the test a measure of abdominal pooling. In fit subjects there was little pooling and, consequently, no appreciable change in heart rate or blood pressure during the test. In unfit subjects in whom a great deal of pooling occurred, the contraction of the abdominal muscles produced an increase in blood return to the right heart and, therefore, the heart rate and systolic blood

pressure rose appreciably.

In a later, more extensive investigation (166), changes in pulse rate and blood pressure during the fatigue test were again analyzed. The changes in pulse rate were found to be so radical that taking the pulse at the radial artery had to be discarded and the practice of recording pulse rates on a smoked drum by means of an arm-cuff substituted.¹ By altering the mixtures of gases breathed before the test, any changes in pulse or systolic blood pressure occurring were found to be the result of mechanical influences during the test and were not due to oxygen depletion or carbon dioxide accumulation. The fluctuations in pulse rate and systolic blood pressure were greater in the more unfit subjects, both during and after the test. These authors, also, attributed this to poorer tone of the abdominal wall.

The Russian government used breath-holding ability as a test of fitness for parachute duty (127). A low "respiratory ratio" (breath-holding time after inspiration/breath-holding time after expiration) indicated unfitness. No data are given in this report. During World War II the possibility of using breath-holding as an aid in escaping from aircraft at high altitudes was studied (152). It was thought that individuals with good breath-holding times could fall through the rarified atmosphere where serious anoxia might occur. However, the excitement and work involved, seriously limited the usefulness of utilizing breath-holding in this manner.

Comparison of Groups. In a study reported in 1920 (74), 124 subjects were divided on the basis of a medical examination into three groups of different degrees of physical fitness. The mean times on both of Flack's breath-holding tests were highest for the group in the best physical condition and the poorest group had the lowest mean scores. Cripps (20) investigated the applicability of Flack's tests of physical fitness for use with the general population. In addition to the results of the examination of 1,258 R.A.F. candidates which were made available to her, Cripps gave the tests to 481 women. Although the data did demonstrate a significantly greater breath-holding ability in men, the authors concluded the test results were too variable for practical use. Hambly and co-workers (71) classified 63 men into five groups ranging from "unfit men" to "very fit men" on the basis of personal knowledge and records of

It has been the present writer's experience that extreme difficulty is encountered in attempting to secure accurate pulse counts with a stethescope, by palpation at the radial artery, or by means of an electrocardiograph during "all-out" breath-holding. Recording from an arm-cuff was found to be most satisfactory.

athletic experience. These investigators found no relationship between either of Flack's breath-holding tests and degree of fitness.

Flack's fatigue test has been used in selecting members of the Cambridge University Crew (107). All candidates were required to hold their breath against 40 mm. Hg pressure for at least 50 seconds. Cureton (22, p. 348) classified 229 men and 42 women in groups according to their swimming times in the 100-yard swim. He found that breath-holding ability varied slightly but positively with swimming ability. He also found the breath-holding times of non-smokers to be on the average 21.2 percent better than those of smokers.

Dane (25) found significant differences in breath-holding after exercise between pubescent and post-pubescent boys (C.R. = 6.7016) and between prepubescent and post-pubescent boys (C.R. = 7.4553). The difference between the scores of the pre-pubescents and pubescents was not significant (C.R. =

0.0234). The age range for these subjects was $10\frac{1}{2}$ to $17\frac{1}{2}$ years.

McCurdy and Larson (115) utilized breath-holding ability in their "Organic Efficiency Test." These workers retained the breath-holding test as one of five items which successfully differentiated between groups at obviously different levels of physical fitness. The breath-holding test was the same as that used by MacKenzie (123). Several years after the initial report was published, additional evidence of validity appeared when convalescents and hospital patients were compared with varsity and olympic swimmers and trackmen (113, 116, 117, 118, 119). McCurdy and Larson (114) also found breath-holding ability, as performed in their organic efficiency test, varied inversely with age. Breath-holding ability was reported to vary with the morphological body type, although adequate evidence to support this contention was not presented (30). According to one writer (98) body build among athletes varies with the extent of heart diminution which occurs during breath-holding against 20 to 60 mm. Hg.

Maximum breath-holding capacity evidently is not sufficiently sensitive to changes in physical fitness among healthy subjects, or psychological factors play such an important part that the test appears to be of little value for individual guidance purposes, although it may have some merit for group classi-

fication.

Correlation Studies. Breath-holding after two minutes of running in place correlates to the extent of 0.30 (tet.) with the total score on a thirty-item battery of motor fitness tests according to Cureton, Welser and Huffman (24). In another study (139, 140) a coefficient of 0.483 was secured between breath-holding after a one-minute run in place and the total score criterion on a nine-teen-item motor fitness battery. This coefficient ranked eighth in validity among the entire battery of tests and last among the four endurance items. The slight spuriousness of the coefficient due to inclusion of the breath-holding test in the criterion was noted by the authors. In Larson's factor analysis (101) breath-holding, as performed in the organic efficiency index, and vital capacity contributed to the formation of a "respiratory factor."

In addition to the studies mentioned above, numerous other investigators have correlated maximum breath-holding times with various physical fitness measures or athletic skills. The results of the correlation work, in general, indicate few relationships of importance. There appears to be little correlation between general motor fitness and breath-holding ability. What little positive relationship exists might be accounted for by slight spuriousness due to the presence of the test in the criterion, and by the common variance due to will power and motivation. The correlation between performance in certain all-out endurance activities with breath-holding appears to be low, but positive (22, p. 294 and pp. 534-5; 23, p. 188; 24; 95). Psychological, as well as physiological factors may be responsible for this relationship. From these coefficients alone. it is not possible to determine which factor is most important. There apparently is little or no relationship between breath-holding ability and motor activities which do not require an all-out effort (22, pp. 534-5; 24). With the exception of vital capacity, there also appears to be no correlation between body structure and maximum breath-holding capacity (20; 22, pp. 534-5; 90; 101; 156). The relationship with vital capacity very likely is positive, but low (probably between 0.1 and 0.2). This is reasonable, since the studies reported in the previous two sections indicated that such a relationship might be expected. The correlation existing between breath-holding ability and blood pressure and pulse rate fitness measures is probably insignificant (20; 22, pp. 334-5 and 534-5; 23, pp. 188 and 231; 95; 101). A correlation coefficient of 0.60 between breathholding ability and the McCurdy-Larson Organic Efficiency Index secured by Larson is partially spurious, due to the inclusion of breath-holding in the Organic Efficiency Index. A correlation coefficient of 0.62 reported between breathholding and the Schneider Index (23, p. 231) appears to be somewhat out of line with other evidence. Perhaps the sample of 23 subjects was an unusual one or the conditions under which the tests were administered were exceptionally well controlled. It seems doubtful whether this coefficient would be of the same magnitude if a larger number of cases were used.

Experimental Studies. Improvement in breath-holding during a 6-weeks training period in cross-country running was demonstrated by McCurdy and Larson (116). The average time for the 9 subjects increased from 32 seconds in the first week to 46 seconds in the sixth week. No controls were employed. A slight increase in breath-holding ability with training for swimming has also been reported (103). No data are given in this paper. An average improvement in normal breath-holding from 39.24 seconds to 68.52 seconds with six months of training was noted by Jokl and collaborators (92, p. 87). Thirty-two subjects with no controls were used. No correlation was observed between improvement in breath-holding and improvement in the 100-yard or the 3-mile run in this study. Henry and Herbig (78) reported that improvement in breath-holding paralleled improvement in running time in track athletes. Cureton (22, p. 508) demonstrated an improvement in one subject of 35 percent in standard scores in breath-holding after exercise with five months of systematic endurance training. He also observed an average improvement of one standard score percent in 15 firemen after seven months of conditioning work (22, p. 509). No controls were employed. In view of the improvement which may be secured simply through practice, these studies should be repeated with adequate controls. Reliability of Breath-Holding Tests. Many of the research workers who have attempted to utilize the length of maximum breath-holding as a test of fitness have commented upon its poor reliability. Several investigators have quantitatively expressed this relative reliability in the form of coefficients. A summary of these results is presented in Table 1. The coefficients range from 0.56 to 0.89 with a mean of 0.73.

TABLE 1
Previously Reported Coefficients of Reliability for Various Breath-Holding Tests

Type of Breath-Holding Test	Coefficient of Reliability	Number of Subjects	Investigator
Normal, after 1 inhalation	0.56	48	Karpovich (95)
Normal, after 3 inhalations	0.89	48	Karpovich (95)
After 1' stepping	0.78	48	Karpovich (95)
After 90" stepping	0.6470*	184	McCurdy and Larson (117)
After 2' run in place	0.78	30	O'Connor and Cureton (140)
After 2' run in place	0.78	171	Cureton (24)
While stepping	0.66	48	Karpovich (95)

^{*} Objectivity coefficient.

Modifications of Breath-Holding Tests. Giorgi (67, 68) believed the difference between alveolar CO₂ tension before and at the end of breath-holding was more valuable as a measure of fitness than simply the time the breath was held. He used this difference in computing the "Alveolar Carbonic Index" which is the square of the difference in alveolar CO₂ tension (mm. Hg) divided by the duration of voluntary apnea in seconds. The test is obviously not practical except in a laboratory situation. Furthermore, little evidence of validity is given for this measure as a means of assessing one's level of physical fitness.

Some evidence is available (72) that the pulse rate immediately after breath-holding may be an indication of physical condition. Ray and collaborators (148, 149, 150) utilized blood reduction time during breath-holding as a measure of fitness. An instrument which is quickly and easily adjusted on the subject, reveals the absorption bands of oxyhemoglobin. The time is measured with a stop watch from the start of breath-holding until the oxyhemoglobin bands disappear. Considerable evidence establishing the test's validity is reported. The test appears to be worthy of further study.

It has been suggested that the effect of breath-holding on the pulse wave be studied as a possible test of fitness (136, p. 18). There is also reason to believe that arterial oxygen depletion rate, using a modified ear oximeter may be useful in appraising circulatory-respiratory fitness.² Considering the onset of respiratory movements as the end-point during breath-holding also appears to have possibilities.²

Additional Studies on Breath-Holding. Besides the studies of breath-holding mentioned in this report, the interested reader may find additional material

² A report of some preliminary validation work with regard to these tests is being prepared for publication.

in theses by Allen (1), Baley (7), Bohrer (12), Brown (15), Buckley (16), Circle (17), Clark (18), Cureton (21), Krizan (99), Kuscher (100), Larson (102), Latham (104), Lux (110), McAdam (111), Montoye (135), O'Connor (139), Olds (141), Pepper (144), Potter (145), Quamme (146), Tomaras (162), Wilson (171) and Wilson (172).

Summary and Conclusions

An attempt has been made to assimilate and evaluate the research on breathholding ability which appeared in physiological, medical and physical education literature for the purpose of clarifying the evidence of validity for this test as a measure of physical fitness. The following conclusions appear to be supported by adequate evidence.

1. The test of maximum breath-holding ability, as commonly administered, has relatively poor reproducibility. This may be due to one or more factors: practice effects are very noticeable; standardization (as for example, amount of air inhaled, intrathoracic pressure, etc.) is generally difficult to attain; motivation, which obviously affects results, may vary from one repetition to the next; or the test may be very sensitive to slight fluctuations in fatigue or other physiological or psychological phenomena.

2. Apparently the controversy over the cause of the breaking-point in breath-holding parallels the controversy over the mode of stimulation of the respiratory center. A careful analysis of the studies reported did not bring to light any conclusive evidence as to whether oxygen depletion or carbon dioxide accumulation is the principal factor in precipitating the breaking point under normal atmospheric conditions. In all probability, as suggested by Rahn and collaborators (147), both are important and additive. When exercise precedes breath-holding, carbon dioxide accumulation becomes more important as the precipitating factor.

3. Diseases of the circulatory system (especially heart disorders), pulmonary tuberculosis and other lung conditions, and infections of various kinds all reduce breath-holding ability very conspicuously. The test is reasonably efficient in differentiating the well from the sick. In most instances the decrease in breath-holding ability varies with the severity of the disease. However, the multitude of pathological changes present in most clinical conditions obscures the actual causes of decreased maximum breath-holding capacity.

 Maximum breath-holding tests either before or after exercise very likely do not measure altitude tolerance.

5. Maximum breath-holding ability is relatively inefficient in differentiating groups of healthy subjects at different levels of physical fitness.

6. Apparently there is little evidence of any correlation between various indexes of physical fitness and breath-holding ability. Even the correlation between breath-holding time and performance in certain endurance-type activities involving motivation and persistency is low, although, in all probability, significant. However, the relationships between breath-holding ability and characteristics of the blood and between breath-holding ability and funda-

mental measures of circulatory capacity evidently have not been determined, or at least have not been reported in the usual channels.

7. Well-controlled experimental studies showing an increase in breath-holding ability which may be attributed to improvement in physical condition as

a result of training are lacking.

8. In devising a test of cardiovascular fitness, it would seem more profitable to concentrate on modifications of breath-holding tests which reduce or eliminate the effects of will-power and motivation, and yet retain the circulatoryrespiratory stress associated with such tests.

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Choice Batting Reaction-Time

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In a recent report (2), the authors presented data on batting reaction-time under two experimental conditions. The first condition in this study involved a measure of the speed with which a batter could start a bat moving upon the presentation of a light stimulus. The second condition involved a measure of the speed with which a batter could change the direction of a moving bat upon presentation of a light stimulus. The batting reaction-times obtained under these conditions were 0.21 seconds and 0.27 seconds respectively. In view of the fact that the experimental conditions involved a simple reaction-time and that an actual batting situation probably involves choice reactions, the obtained times were presented as being representative of the possible minimal limits of batting reaction-time.

To attain some estimate of the maximal limits of batting reaction-time, a second investigation was undertaken. The study herein reported is concerned with choice batting reaction-time. The experimental conditions involve a starting and a movement reaction-time.

Method and Procedures

Since the apparatus, with its electrical circuit, has been described in an earlier publication (2), it will not be reported here in detail.

Briefly, both the starting and movement reaction-times were measured by having subjects move a regulation baseball bat across the surface of a specially constructed curved rail. A vertical contact at the right end of the rail provided a starting point for the swing. This contact also served as a switch for measuring the starting reaction-time. Movement of the bat away from the contact broke the circuit and measured the instant at which the bat started its forward movement.

Contacts spaced along the surface of the rail served as switches to measure the movement reaction-time. These contacts were wired so that movement of the bat across the rail controlled the instant at which the stimulus and the timing clock were activated. A simple switching arrangement made it possible to close the circuit at 15, 30, 45, 60, or 75 degrees from the starting point. Movement of the bat off the contacts broke the circuit and measured the time required to change the direction of a moving bat.

The visual stimulus to which the subjects reacted consisted of four neon glow lamps. These lamps were mounted on a vertical panel to give a pattern of two vertical lights and two horizontal lights. The light circuit was so wired that either the vertical or the horizontal lights could be turned on by the manipula-

tion of a knife-switch. Turning on the lights also started a 0.01-second standard electric clock. The light panel was mounted 60 inches beyond the left end of the rail and 54 inches from the floor.

The starting reaction-time was measured by having the subject stand midway between the ends of the rail and assume a batting stance. In this position his bat rested against the vertical contact, and the light panel was directly in line with his left shoulder. At the signal "Ready," the subject concentrated on the light panel and the reaction to be made. Choice starting reaction-time was measured by having the subject swing the bat forward only when the horizontal lights appeared. When the vertical lights appeared, the bat was kept against the starting contact. The time interval between the signal "Ready" and the appearance of the visual stimulus was varied during a series of trials. These intervals were approximately one, two, and three seconds arranged in random order.

In measuring the movement reaction-time, the subject assumed the same position described above. At the signal "Ready," the subject swung the bat along the rail. Choice movement reaction-time was measured by having the subject raise the bat off the rail only when the horizontal lights appeared. When the vertical lights appeared, he continued swinging his bat along the rail. In both experimental situations, the sequence of light patterns in a series of trials was arranged in random order.

Twenty-five reaction-time measures were obtained for each experimental situation. An explanation and demonstration was given by the experimenter before each series of trials. Following this, the subject was permitted to practice until it became evident that he understood the desired reactions.

Twenty-five male physical education majors of Indiana University served as subjects. Their ages ranged from 21 to 29 years, their median being 24 years.

TABLE 1

Data on Choice Starting and Movement Reaction Time

(In Seconds)			
Basis	Mean	σМ	
Starting R. T.	0.293	0.008	
Movement R. T	0.344	0.007	
Difference	0.05		
t	6.737		
P	0.01		

Results and Discussion

The data obtained on choice reaction-time are summarized in Table 1. For the subjects used in this experiment, the choice starting reaction-time was approximately 0.29 seconds and the choice movement reaction-time 34 seconds. That the difference between choice starting and movement reaction-time is significant is revealed by a t value of 6.737. For 24 degrees of freedom, a t value

of 2.797 is significant at the one percent level of confidence. The hypothesis that this difference can be attributed to chance is therefore rejected.

A comparison of the choice reaction-times found in this experiment with the simple reaction-time reported in an earlier study reveals that the latter are considerably shorter. In the earlier report the starting reaction-time was found to be 0.21 seconds and the movement reaction-time 0.27 seconds. These results are in complete agreement with other comparative studies of simple and choice reaction-time.

It is also of interest to note that both studies show the starting reaction-time to be significantly shorter than the movement reaction-time. The implication of this finding is that it would be a decided advantage for the batter to make his reaction to a ball in flight a starting rather than a movement reaction. With a starting reaction, the batter would have a longer period of time to observe the ball in flight before starting his swing. This, presumably, would give more accurate knowledge as to where the ball will be when it passed over home base.

The magnitude of the choice reaction-times obtained in this study casts serious doubt upon the common assumption that a batter can delay his swing until the ball is within a few feet of home plate. Scott (1), for example, cites data indicating that a fast thrown ball takes from 0.43-0.53 seconds to travel from the pitcher to home base. If these values are taken as being representative of the average time of ball flight, it becomes evident that a batter cannot wait until the ball is within a few feet of home base and still have time to make a choice reaction. Assuming that the ball travels at uniform velocity, a choice starting reaction would require the ball to be from 30 to 41 feet from home base. To have sufficient time to make a choice reaction, the ball would have to be from 35 to 48 feet from home base. Actually, a ball in flight would probably be slowed down to some extent by air resistence, and this factor would tend to shorten the distances required for successful choice reactions. It must be remembered. however, that the reaction-time measures did not include the time required to bring the bat forward to a position where the ball is hit. If this time were added to the reaction-time, it would probably more than compensate for the deceleration effects of air resistance.

From the experimental data reported in this study, it would appear that a batter must obtain information as to where the ball will be as it passes over home base before the ball reaches the midpoint of its flight. After the ball has passed this point, there would no longer be time for a batter to react to any changes in the ball's direction of flight.

Summary

The choice batting reaction-time of 25 physical education majors was measured under two experimental conditions. It was found that the mean choice starting reaction-time was approximately 0.29 seconds and the mean choice movement reaction-time 0.34 seconds.

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The Harvard Step Test as a Measure of Endurance in Running

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In A previous investigation (1) conducted on aviation cadets it was found that the Harvard Step Test score correlated 0.38 with the time of a cross-country run. Although this correlation is not high, it indicates that the Harvard Step Test might be used as a rough test of running endurance. Since cadets were not specifically trained for endurance runs, it was decided to repeat the investigation on men undergoing intensive training for distance races—marathon and cross-country.

Procedure and Method

The present study may be divided into two parts:

1. Relation of training in running to the Harvard Step Test score.

2. Relation of the Harvard Step Test score to the order in which subjects finished marathon and cross-country races.

Method. Five groups of subjects, all males, were used in this study. All of them, except marathon runners, were college students.

1. Marathon runners, trained for distances of over 10 miles.

2. Varsity cross-country runners, trained for distances of four to five miles.

Freshman cross-country runners, trained for two and a quarter to three and a quarter miles.

4. Sprinters and hurdlers, trained for distances not over 220 yards.

 Sedentary individuals, taking part only in class physical activities not more than three times a week.

The fourth and fifth groups were used only as controls in dealing with the first experimental problem, namely the effect of training in running upon the Harvard Step Test Score.

All runners were given the Harvard Step Test (the rapid form)¹ as close as it was possible to the day of the race in which they participated. On the day of the race the running time and the place at the finish were recorded.

Results

1. Relation of training in running to the Harvard Step Test Score.

Examination of Table 1 shows that if the groups are arranged according to decrease in the mean scores of the Harvard test, the order will be: (1) varsity

¹ In the rapid form of this test the pulse rate is taken only once, i.e., from 60 to 90 seconds after the discontinuation of stepping (2).

group, (2) freshman group, (3) marathon runners, (4) sprinters and hurdlers, and (5) sedentary group. It is significant that whereas there were no scores lower than 83 in the varsity group, there were scores as low as 20 in the sedentary group and no score higher than 85.

A statistical analysis of differences between the obtained mean scores was made, and the results are presented in Table 2. In order to obtain a clear picture

TABLE 1

Harvard Step Test Scores for Runners and Sedentary Men

Groups	N	Range	Mean Harvard Step Test Scores	S.D.	S.E.
Varsity cross-country	30	83-170	111.5	23.00	4.26
Freshman cross-country	18	75-156	105.28	19.68	4.78
Marathon runners	13	75-133	98.58	15.00	4.34
Sprinters and hurdlers	21	68-101	86.45	8.56	1.91
Sedentary individuals	22	20-85	62.42	16.60	3.62

TABLE 2
Significance of Differences Between Means of Harvard Step Test Scores of Runners and Sedentary Men

Means	Difference	S.E. _D	ŧ
M ₂ -M ₁	12.92	6,08	2.13*
Ma-Ma	6.70	6.44	1.04
M ₁ -M ₄	12.13	4.73	2.56†
M ₁ -M ₅	36.13	5.65	6.39†
M_2-M_3	6.22	6.40	0.97
M2-M4	25.05	4.68	5.35†
M ₂ -M ₅	49.05	5.60	8.76†
M ₃ -M ₄	18.34	5.14	3.66†
M ₃ -M ₅	32.83	5.99	5.48†
M ₄ -M ₅	24.00	4.10	5.85†

Key: M1 = Marathon runners.

M₂ = Varsity cross-country runners.

M₁ = Freshman cross-country runners.

M₄ = Sprinters and hurdlers.

M4 = Sedentary individuals.

* Significant at the 0.05 level of confidence.

† Significant at the 0.01 level of confidence.

of the inter-relations between these means, it will be more convenient, however, to use Table 3. One can see from this table that there were statistically significant differences of means between:

(a) Sedentary men and all other groups.

(b) Sprinters-hurdlers and all other groups.

(c) Varsity men and all other groups except the freshman group.

(d) Marathon runners and all other groups except the freshman group.

There was no significant difference between the mean scores of the marathon runners and the freshman groups and between the varsity and freshman groups.

2. Relation of the Harvard Step Test score to the order in which the subject finished marathon and cross country races.

For determination of this relationship a rank difference method was used.

The significance of rho was tested against the null hypothesis.

The pertinent statistical data are given in Table 4. The only statistically significant correlation (0.63) was found for the Springfield College Intramural cross-country race.

TABLE 3
Statistical Significance Between the Mean Harvard Step Test Scores Obtained on Runners and Sedentary Men

	Groups	Marathon 1	Varsity c.c. 2	Freshman c.c.	Sprinters & hurdlers 4	Sedentary men 5
1. Marathon runr	iers	o	X	_	X	X
2. Varsity cross-c	ountry	X	0	-	X	X
3. Freshman cross	s-country		_	0	X	X
4. Sprinters and l	urdlers	X	X	X	0	X
			X	X	X	0

X = Statistically significant

TABLE 4

Rank Difference Correlations Between Harvard Step Test Scores and the Order of Finish in Distance Races

Marathon and Cross-Country Runs	N	rho
Marathon, Boston Athletic Assoc, Cross-Country	7	0.32
New England Inter-Collegiate (Varsity)	25	0.03
Connecticut Valley (Varsity)	17	0.03
New England Inter-Collegiate (Freshman)	12	0.42
Connecticut Valley (Freshman)	9	0.18
Springfield College Intramural	12	0.63*

^{*} Significant at 0.01 level of confidence.

Discussion

Although this investigation definitely indicated that men trained in endurance running have a higher Harvard Step Test score, it also showed that marathon runners scored less than either varsity or freshman cross-country men. The explanation for this apparently paradoxical observation may be found in the nature of the Harvard Step Test and in the manner in which marathon runners run.

The Harvard Step Test requires a high knee elevation in order to step on the 20-inch bench. This exertion may cause a considerable amount of local fatigue and acute pain in the knee joints especially in sedentary people.

During this investigation it was observed that the marathon runners had a certain difficulty in maintaining the required cadence of the stepping-up exercise. Furthermore, most of them complained of muscle soreness throughout the thigh, groin, and calf for several days following the test. The varsity and

^{- =} Not significant

freshman cross-country groups, on the other hand, had no difficulty in keeping cadence, and the soreness seemed to center about the calf muscles and achilles tendon. The sprinters and hurdlers apparently experienced the least discomfort on the days following the test.

A possible explanation is that marathon runners, intent upon economy of energy, use a short stride which does not require the foot to be raised far off

the ground—hence their difficulty in performing the step test.

The lack of a statistically significant correlation between the Harvard Step Test Scores and the order of race finish in all groups but one may be due to several reasons. First, the method of rank difference used to correlate the two variables does not take into account actual performance in terms of time and score, but only the rank of time (order of finish) and the rank of scores. Hence, individuals who were only two to three seconds apart were ranked on the same basis as those who finished the race two to three minutes apart. Secondly, there was no way in which to control the emotional adjustment to the step test experience which was new to the majority of the subjects.

However, the coefficient of correlation of 0.63 for the Springfield College Intramural Cross-Country Run, significant at the 0.01 level of confidence, and the correlation of 0.42 (approaching significance) for the Freshman New England Inter-Collegiate Cross-Country Run may indicate that the test reflects the order of finish with greater accuracy in relatively inexperienced runners.

Conclusions

1. The Harvard Step Test Score is affected by training in distance running such as marathon and cross-country. The 104 tested subjects ranked according to their mean scores as follows: Sedentary—62.45; Sprinters and hurdlers—86.45; Marathon runners—98.58; Freshman cross-country—105.28; Varsity cross-country—111.5.

2. Since in marathon running the elevation of the feet is reduced to a minimum, marathon runners experience discomfort in doing the Harvard Step Test and have a lower score than cross-country men, whose training requires higher

elevation of legs.

3. Only in the Springfield College Intramural Cross-Country Race was there a statistically significant rank difference correlation (0.63) between the Harvard Step Test score and the order in which men finished the race.

REFERENCES

 KARPOVICH, P. V., "A Comparative Study of Behnke and the Harvard Step-up Tests for Physical Fitness." Report 1, Project 148, A.A.F. School of Aviation Medicine, Randolph Field, Texas, Aug. 5, 1943.

SCHNEIDER, E. C., AND P. V. KARPOVICH, Physiology o Muscular Activity 3rd ed., Philadelphia: W. B. Saunders Co. 1948.

Research Abstracts

Prepared by the Research Abstracts Committee of the National Council of the Research Section, Carolyn W. Bookwalter, Chairman

Anatomy, Anthropology, nd Physiology

36. Howells, William White. Factors of human physique. Am. J. Phys. Athrop., 9: 2 (June 1951).

There is a need for further analytical techniques, especially statistical ones, in anthropometry. Factor analysis is discussed as one such technique. An analysis is made, based on 152 Wisconsin students, of a set of measurements largely of the head and face. Seven factors are found, interpreted as general body size, long bone length, cranial (skeletal) size, brain size, lateral facial-cranial development, face length, and ear size. The factors found necessarily depend greatly on the set of measurements used, and in the case of at least three, possibly four, factors all that can be said is that certain groups of measurements are factorially distinct and independent (long bone length, face length, ear size). In the cranial vault and facial breadth, however, more meaningful factors appear, especially in the distinction between brain size, head size, and lateral development; and above all between brain size and all other factors of this set. Some comments are possible on the significance of certain measurements. Head length appears as principally associated with general head size, and not with brain size, while head breadth is associated principally, or at least strongly, with brain size. This may explain the fact that these two measurements have always been found to have a relatively low correlation. Stature, head circumference, and to a great extent bizygomatic breadth, are complex measurements, reflecting the influence of more than one basic factor.-The Wistar Institute.

BODIAN, DAVID, AND DOMINIC DZIEWIATKOWSKI. The disposition of radioactive phosphorus in normal, as compared with regenerating nervous tissue. J. Cell. and Comp. Physiol., 35: 2 (Apr. 1950).

The distribution of phosphorus in inorganic, acid-soluble, lipid, and protein fractions of certain nervous tissues of the rhesus monkey was investigated, and the uptake of radiophosphorus in these fractions was subsequently studied. Gray matter was found to have high levels of acid—soluble P and low levels of lipid P as compared with white matter. "Residual P" (nucleoprotein and protein) was low in caudate nucleus ("pure" gray) and in peripheral somatic nerves, as compared with levels in corpus callosum, cerebral cortex, or spinal cord gray.

Regenerating nerve (proximal stump of severed nerve) differed little in P content from normal nerve, except that "residual P" seemed slightly higher. Degenerating nerve (distal stump) contained reduced levels of acid-soluble P and lipid P, probably attributable to degeneration of exoplasm and myelin, respectively, and increased levels of "residual P," probably the result of Schwann cell proliferation. Uptake of radiophosphorus and turnover appear to be low in all P-containing fractions of normal nervous tissues. In contrast, regenerating nerve (proximal stump) and degenerating nerve (distal stump), about one week after nerve section, shows relatively much greater uptake of P³² in all P-containing fractions. This increase over normal is less marked, especially in the "residual P" fraction, one month after nerve section.—The Wistar Institute.

 Schwadron, Lester, and Benjamin Charles Moffett, Jr. Relationships of cranial nerves to Meckel's cave and the cavernous sinus. Anat. Rec. 106: 2 (Feb. 1950).

The relationships of the cranial nerves to Meckel's cave and the cavernous sinus were studied in children and adult cadavers. Meckel's cave is formed by an evagination of the

inner layer of the dura and contains the motor and sensory roots of the 5th nerve and most of the trigeminal ganglion. The cave extends almost to the foramen ovale on the inferior lateral surface of the ganglion while it is less extensive on the superior medial surface, where the meningeal dura is reflected onto the ganglion at the midpoint of its length. Approximately the posterior two-thirds of the mandibular nerve pierces the meningeal dura to join the Gasserian ganglion as it lies within Meckel's cave. The motor root is in relation to the anterior fibers of the mandibular nerve which together with the ophthalmic and maxillary divisions join the ganglion anterior to the cave. The cavernous sinus is related to the oculomotor, trochlear, abducens nerves and the ophthalmic and maxillary divisions but does not extend inferiorly to the mandibular nerve.—The Wistar Institute.

 STEIN, ARTHUR HENRY, JR. Variations of the tendons of insertion of the abductus pollicis longus and extensor pollicis brevis. Anat. Rec., 110: 1 (May 1951).

The wrists of 42 cadavers were dissected in order to determine the frequency of accessory tendons of insertion of the extensor pollicis brevis and the abductor pollicis longus muscles. In these 84 wrists accessory tendons of the extensor pollicis brevis were found 3 times (4%) and of the abductor pollicis longus 57 times (68%) in the region where these two tendons pass through the same osteofibrous canal. It would appear then, that in addition to the usually described tendon of insertion of the abductor pollicis longus (into the base of the first metacarpal) there is present an accessory tendon, demonstrable within just proximal to, or just distal to the osteofibrous canal, which inserts into the trapezium or into the muscles and fascia of the thenar eminence. Although 84 wrists do not comprise a large series, there is no evidence of a race or sex difference since an accessory tendon of the abductor pollicis longus is present in either 67% or 68% of each group of Whites, Negroes, males, and females.

The incidence of other less common variations, such as absence of doubling of the tendon of the extensor pollicis brevis, bilateral assymetry, and a double osteofibrous canal for the two tendons are noted and also were described.—The Wistar Institute.

Education and Safety Education

 BATCHELDER, HOWARD T. AND SHIRLEY H. ENGLE. Some characteristics of the secondary school of the future in light of modern developments. *Bulletin of the School of Education*, Indiana University, 27: 3 (May 1951).

Twenty-three experienced teachers of secondary school subjects were selected to participate in a workshop, which was conducted for four weeks. In all, 33 conclusions as to needed changes in the secondary school were developed through a process of group thinking. Five major conclusions were: (1) the secondary school must concern itself more centrally with the development of good human relationships among pupils, teachers, administrators, the community, and the world at large; (2) the secondary school must provide opportunities for pupils to learn what atomic energy is, what it can do, how it affects their lives, and how it may affect their lives in the future; (3) the secondary school must concern itself with the development in students of the knowledge and skills necessary for intelligent and discriminating use of mass media of communication; (4) the secondary school must concern itself with the development in students of a better understanding of the economic and social forces which operate in the modern world; and (5) the secondary school must do a much better job than it is now doing in providing a free and appropriate educational program for youth. The job of teaching in the secondary school was concluded to be a continuous one, requiring courage, devotion to the task, much information, a sense of direction, and high intelligence. - Carolyn W. Bookwalter.

41. Forsythe, Charles E. Statistically speaking. Safety Education, March 1950, p. 6. This is the report of a study made by the Michigan, Wisconsin, and Minnesota State High School Athletic Association on accident rates in high school football. It was found that dental, face, and nose injuries were the most common types, running plays are the most hazardous, tacklers and blockers are the most prone to injuries and that there is greater incidence of injury in regular games than in practice ones.

In regard to equipment, one type of properly fitting, smooth-surfaced helmet is no more dangerous than another, but ridges and sharp edges are dangerous. Properly fitting shoulder pads with adequate inside and outside soft coverings are essential and there seems to be a relationship between shoulder injuries and inadequate elbow padding. Unless the knee pads which are part of the pants are held in place by snugly fitting pants, separate knee pads should be worn, and since pelvic injuries are the most serious it is most important that hip pads have enough padding and fit the wearer properly.—Harriet G. McCormick.

 National Education Association. Salaries and salary schedules of city-school employees, 1950-51. Research Bulletin, 29: 2 (Apr. 1951).

A total of 2,438 cities were included in the survey which included 55.8% of all school systems in cities above 2,500 population and 89.7% of the school systems in cities with more than 30,000 population. For classroom teachers with four years of preparation or bachelor's degrees, the medians of minimum salaries ranged from \$2,466 to \$2,660. The medians of the maximum salaries ranged from \$3,938 to \$4,700 for bachelor's-degree teachers. Almost all of the larger cities report the use of a definite salary schedule. Teachers are less well off in relation to the employed persons in general than they were in 1940, as the average teacher in 1949 earned 99% more than in 1940 but the average employed person earned 120% more than in 1940. The medians of increments given range from \$106 to \$175.—Carolyn W. Bookwalter.

43. SPADAFORA, JENNIE. Target gymnasium. Safety Education. January, 1950. p. 8.

A study of the school building accident rates as reported to the National Safety Council for 1948-49 showed that more than two-fifths of the accidents occurred in the gymnasium, swimming pool and shower room where a relatively small amount of the student's time is spent.

A breakdown of the average rates per 100,000 showed, interestingly enough, that the rate for the swimming pool and showers which usually are looked upon as most hazardous was lowest, 0.13, while basketball was next, 0.36, and other gymnasium activities highest, 0.86.

The lowest average accident rate was found in the elementary school, the junior high school (grades 7-9) was next and the highest in the senior high school (grades 10-12). The greatest total number of accidents occurred in January and February.—Harriet G. McCormick.

44. STAPLEY, MAURICE E. Attitudes and opinions of school board members in Indiana cities and towns. Bulletin of the School of Education, Indiana University, 27: 2 (March, 1951).

Returns of questionnaires were received from 297 (53.0%) of board members and from 123 (76.9%) of the superintendents. Fifty-eight questions were asked. Some of the conclusions reached were: board members should be selected without reference to political party, church affiliation, or representation of a given group or population segment; board members who will give freely of their time should be chosen; there should be no hesitation in selecting women to school board membership; experience as a teacher is not necessarily good training for school board membership; there is no agreement as to the best method of selecting school board members; and standing committees of school board members are undesirable.—Carolyn W. Bookwaller.

Nutrition

 BIERI, JOHN GENTHER. Stability of aqueous and oily vitamin A and carotene solutions. *Journal of Nutrition*, 44: 2 (June 1951).

Dilute solutions of crystalline vitamin acetate or purified β -carotene were prepared in a Tween 40-water solution or in cottonseed oil. The composition of the solutions and the concentration of anti-oxidants were: stored under nitrogen at 7°C. Samples were removed at intervals and analyzed. Carotene was determined spectrophotometrically and vitamin A by the antimony trichloride method.

The percentages of carotene or vitamin A remaining after 50 days of storage varied from 89% to 98%. Similar aqueous solutions of vitamin A acetate and carotene using Tween 40 and Tween 80, without anti-oxidants, were stored under air or nitrogen at 7°C. Vitamin A

solutions were stable for at least 28 days (9 % remaining) regardless of atmosphere or dispersant. Carotene in Tween 40 solution, under nitrogen, was stable for the same period. In Tween 40 under air, or in Tween 80 under air or nitrogen, carotene deteriorated rapidly (30 to 50%) in 28 days.—The Wistar Institute.

46. COOK, BESSIE BURKDOLL, AGNES FAY MORGAN, ELSIE ORR WEAST, AND JANICE SLATER PARKER. The effect of heat treatment on the nutritive value of milk proteins. (Evaporated

and powdered milks). Journal of Nutrition 44: 1 (May 1951).

Ordinary sterilization or preheating temperatures used in the preparation of evaporated skim milks were found to decrease the protein efficiency of the milks, as measured by rat growth, in proportion to the degree of heat used. While the damage to the nutritive value of protein was not marked at temperatures commonly used, it may be increased by careless overheating in commercial preparations of the products and in cooking. As an example of this, commercially prepared evaporated milks, given additional heating in a pressure cooker at 120°C. for 30 min., had decreased protein efficiency when compared with the original evaporated milk. A group of rats fed these overheated evaporated milks grew steadily for sixteen months but, even though they were fed ad libitum, never attained the weights of a similar group of animals fed the evaporated milk lacking the extra heat treatment. Exhausting the evaporated milk cans of oxygen and replacing it with nitrogen gas before sterilization did not prevent the damage to the protein by the heat of sterilization. The changes which took place in the protein (probably the protein-lactose reaction) did not appear to be dependent upon the presence of oxygen.—The Wistar Institute.

47. COOK, BESSIE BURKDOLL, JANE FRAENKEL-CONRAT, BEATRICE SINGER, AND AGNES FAY MORGAN with the technical assistance of Rae Buell and Joan Greenburg Moises. The effect of heat treatment on the nutritive value of milk proteins. *Journal of Nutrition*,

44: 2 (June 1951).

Raw casein, two types of lactose-free lactalbumins, and a commercially prepared lactose containing lactalbumin were subjected to heat or lactose combination, or both. The digestibility, by the a amino nitrogen and the biologically available lysine, methionine, and tryptophan, and the basic groups were measured in enzyme hydrolysates of all of these protein preparations. These proteins could be combined with 2% to 8% of lactose, depending upon the conditions of the reaction. After acetylation of the amino groups, the casein combined with a small amount of lactose, the lactalbumins did not. The decrease in digestibility as a result of dry heat treatment was only slight in A (soluble) lactalbumin, but was slightly more in the ethanol-precipitated lactalbumin and casein. Further decrease in digestibility was noted in these proteins in proportion to the amount of lactose combined and to the degree and duration of heat applied after reaction with lactose. Little effect of heat on the availability of the amino acids measured was noted in the lactose-combined proteins heated for 30 min. at 118°C. and digested for 72 hrs.—The Wistar Institute.

48. CRAMPTON, EARLE WILCOX, ROBERT HADDON COMMON, FLORENCE AMELIA FARMER, FLORENCE MARION BERRYHILL, AND LIZARE WISEBLATT. Studies to determine the nature of the damage to the nutritive value of some vegetable oils from heat treatment. Journal

of Nutrition, 44: 1 (May 1951).

Investigations to identify the nutritionally deleterious substances in polymerized linseed oil were conducted by aggregating the products of polymerized oil into separate fractions through the use of solvents and distillation. The toxic material was shown to be associated with the glyceride constituents of the oil. It did not seem to be solely related to the higher polymers nor to the dimeric glycerides. However, the injurious material appeared to be concentrated in the dimeric residue from the ethyl esters of the acetone-soluble fraction of heated oil. Therefore, either the domeric fatty acid radicals themselves or some compound also present in the dimeric residue are responsible for the low nutritive value of heated linseed oil. The adverse effects of the toxic material appeared to be intensified by the absence of some essential nutrient, possibly certain unsaturated compounds at whose expense they were produced.—The Wistar Institute.

 PECORA, LOUIS AND JAMES M. HUNDLEY. Nutritional improvement of white polished rice by the addition of lysine and threonine. *Journal of Nutrition* 44: 1 (May 1951).

Highly significant improvement of natural rice protein as it exists in polished rice has been accomplished by the addition of two essential amino acids, lysine and threonine. This combination produced a growth response in white rats three times that obtained with an unsupplemented rice diet. Rice plus lysine and threonine, supplemented with all the other essential amino acids individually, or with all the possible combinations of three and four of the remaining essential amino acids, was not further improved. Rice supplemented with each of the essential amino acids individually was not improved biologically, as determined by rat growth response. The results of these experiments indicate that lysine and threonine are the most deficient essential amino acids and that they are about equally limiting for rat growth. A three-fold excess of arginine or methionine, when added to rice completely supplemented with all the other essential amino acids produced a significant growth depression, while an excess of the other essential amino acids individually was without effect.—The Wistar Institute.

50. Sugiura, Kanematsu. On the relation of diets to the development, prevention and treatment of cancer, with special reference to cancer of the stomach and liver. Journal of Nutri-

tion, 44: 3 (July 1951).

When rats were fed p-dimethylaminoazobenzene (Butter Yellow) in a rice diet the incidence of hepatic tumors (cholangioma) at 100 to 200 days was about 90%. When rancid, stale, or moldy rice was used as the basal diet, the tumor incidence was definitely reduced. The addition to the rice diet of 15% yeast, beef liver or dried milk inhibited the production of liver cancer by Butter Yellow (200 days). Daily oral administration of 200 µg of riboflavin to rats the Butter Yellow-rice-casein diet resulted in almost complete inhibition of liver cancer. However, the protection against liver cancer formation by yeast, liver, milk, or riboflavin is not permanent. In animals which died or were sacrificed between 400 and 800 days only 25% to 15% had normal livers. A majority of rats which received preliminary feeding with Butter Yellow for sixty days had cirrhosis of the liver. When this ration was followed by rice alone, 85% of the animals subsequently developed liver cancer. However, of rats which received preliminary feeding with Butter Yellow for 60 days and a subsequent rice diet containing 15% of yeast, liver or dried milk for 250 days, 25% developed liver cancer, while 75% were found to be without cirrhosis or cancer. However, once adenomatous hyperplasia of the bile ducts, cholangioma, or hepatoma had been established in the liver, these benign and malignant tumors could not be destroyed by ingestion of yeast, liver, or milk.—The Wistar Institute.

51. TAYLOR, CLARA MAE, ORREA FLORENCE PAYE, MARY LOUISE SCHAFER, AND SHIRLEY MAE WING. The energy expenditure of boys and girls 9 to 11 years of age (1) washing and wiping dishes, (2) boys engaged in carpentry, and (3) girls sewing. Journal of Nutrition,

44: 2 (June 1951).

Twenty-four determinations of the energy expenditure for washing and wiping dishes were carried out in a respiration chamber. The subjects were 10 boys and 8 girls, 9 to 11 years of age, 12 determinations being made on the boys and 12 on the girls. The results are reported as the total expenditure, i.e., inclusive of the basal metabolism. The average expenditure by the boys was 2.92 Cal. per kg. of body weight per hour or 0.75 Cal. per cm. per hour. Fourteen determinations were made of the energy expenditure of 10 boys, 9 to 11 years of age, doing carpentry work in the chamber. The average expenditure was 3.58 Cal. per kg. per hour or 0.87 Cal. per cm. per hour. Thirteen determinations of the energy expenditure of 9 girls, 9 to 11 years of age, while sitting sewing in the respiration chamber were carried out. The average expenditure was 1.85 Cal. per kg. per hour or 0.47 per cm. per hour.—The Wistar Institute.

52. THOMPSON, ETHEL MARION, MARY EVELYN ROBERTSON BAL, EDNA MAE MCINTOSH, GRACE MACLEOD, AND CLARA MAE TAYLOR. The energy expenditure for quiet play and cycling of girls 6 to 14 years of age. *Journal of Nutrition* 44: 2 (June 1951).

Fifty-four determinations of the energy expenditure for quiet play and 55 for cycling by 20 girls, 6 to 14 years of age, are reported. A respiration chamber was equipped with a bicycle, i.e., including the basal metabolism. Twenty determinations were made on girls 6 to 9 years of age. For quiet play the average energy expenditure was 2.80 Cal. per kg. per hr. or 0.57 Cal. per cm. of height per hr. For cycling the average was 6.19 Cal. per kg. per hr. or 1.27 Cal. per cm. of height per hr. Twenty determinations of the energy expenditure for quiet play and 21 for cycling on girls 10 to 12 years of age gave for quiet play an average expenditure of 2.38 Cal. per kg. per hr. or 0.55 Cal. per cm. of height per hr. For cycling, the energy expenditure was 4.93 Cal. per kg. per hr. or 1.14 Cal. per cm. of height per hr. Fourteen determinations were made on girls 12 to 14 years of age. The average energy expenditure for quiet play was 1.85 Cal. per kg. per hr. or 0.57 Cal. per cm. of height per hr. For cycling the average was 3.31 Cal. per kg. per hr. or 1.01 Cal. per cm. of height per hr. —The Wistar Institute.

Book Review

OBERTEUFFER, DELBERT, Physical Education, New York: Harper and Brothers, 1951, 374 pp.

This textbook for professional students of physical education is concerned with the underlying principles used to guide and administer physical education programs. It should be useful for teachers already in service for it is an up-to-date source of physical education philosophy together with ideas for putting the philosophy into action. The practice and principles of democratic administration and a consideration of the physical education curriculum is given broad coverage. Personal resources and social relationships are discussed thoroughly in the light of intramural, interscholastic, and recreational activities.

The author states in his introductory pages that an effort is made here "to describe the soil out of which a modern program of physical education grows." Thus the biological and social elements of education through physical activity are given considerable treatment in the book. Oberteuffer makes a real plea for physical education personnel to plan, conceive, and execute the program "in step with the best purposes and procedures of education and have no objectives different from those acceptable to education in a democracy." Thus, he pleads for integration in education, rather than segmentation, and proceeds to show how physical education may fit into the scheme of things. Carl E. Willgoose.

Report of Committee on Criteria for Evaluation of Articles Submitted for Publication in the Research Quarterly April 1950

I. General Editorial Policy

1. Material suitable for publication shall include reports of research studies, articles reviewing research, and lists of titles of theses completed.

(a) Research studies may utilize any sound method of investigation, e.g., experimental, historical, philosophical, statistical.

The research shall not have been published previously.

Reports based on research for which the magisterial or doctoral degree has been granted, shall be judged, for content and form, by the same criteria as those presented herewith for evaluating other reports.

Note: Abstracts of degree dissertations either published or unpublished, may be submitted for publication in the section devoted to abstracts. An acceptable abstract should conform to those standards for abstracts established by the editor of the Research Quarterly or other properly constituted authority, i.e. Research Council's Committee on Abstracts.

(b) Review articles shall be critical, comprehensive and of current significance.

(c) Lists of titles of theses and other unpublished research studied shall be accepted for publication provided that a plan for systematic and complete coverage of such material is developed.

Membership of the author in the AAHPER or in any other organization or institution shall not influence acceptance or rejection of a manuscript submitted.

3. Manuscripts submitted shall be reviewed independently by at least three associate editors whose familiarity and competence in the area of the research presented is well established.

Approval of at least two of the associate editors is necessary for acceptance. While the decision of the associate editors is final, provision should be made for reconsideration by the same or other associate editors if the author seems to have basis for appeal.

4. As a general rule, manuscripts accepted shall be published in order of submission. However, exceptions may be necessary if acceptance of the manuscript is dependent upon revisions suggested by the associate editors.

5. The author shall be notified by the editor at the time of acceptance of the approximate date of publication.

II. General Statement of Function of Associate Editors

The guiding principles of the associate editor in reviewing and judging manuscripts shall be (1) to maintain a high standard of scholarship in the publication and (2) to encourage and assist research workers in meeting these standards.

The associate editor should be competent in the area of study of the manuscript under consideration,—familiar with factual data and with research methods and tools available; sensitive, open-minded and critical in recognizing new ideas and methods and in evaluating new data. He should be thoroughly objective and impartial in his review, basing judgment solely upon evidence presented not upon opinion of either associate editor or author. He must recognize and control an almost inevitable human tendency to bias and avoid any hint of censorship in his judgment.

The associate editor should be alert in recognizing intrinsic merit and potentially valuable contribution in a study which may be poor in its presentation or incomplete in its development. A constructive sympathetic attitude on the part of the associate editor with positive suggestions to the author for revision or extension of either the report or the research represented will help to salvage both the accomplished research and the worker. An overly harsh attitude may

lose both to the profession.

The associate editor in accepting his appointment should be fully informed and aware of the responsibility involved, and the importance of carrying out his assignments not only with good judgment and fairness, but also with dispatch.

If for any reason he is unable to devote the necessary time and effort to do good reviewing promptly, he should take the initiative in resigning as as as-

sociate editor.

III. Specific Criteria for Evaluation with Respect to Content

1. The merit of the research article shall be judged in terms of its contribution to knowledge, either as new information, substantiation or contradiction of previous findings or application of new or improved research techniques to old problems.

2. The subject matter should be pertinent to health, safety, physical educa-

tion and/or recreation.

3. The data presented should warrant a reasonably definite conclusion, i.e. should not be merely a progress report. However, the extent or comprehensiveness of research reported should not be the sole basis for acceptance or rejection. A report of the early stages of a research study may be valuable for the information per se and/or as a guide to other workers.

4. Good scholarship should be evidenced both in the design and execution of

the study, and in the interpretation of the data presented.

Following is a suggested list of important elements in a well-conducted investigation:

(a) The problem is significant.

(b) The problem is adequately delimited and clearly stated.

(c) The methods used are appropriate and adequate to yield data necessary for the solution of the problem.

(d) The methods and procedures used in collecting the data are clearly described with evidence of precision of measurement included.

(e) If the problem is such that quantitative analysis of the data is indicated, the statistical methods used are appropriate and adequate.

(f) In a philosophical or historical study, thoroughness, objectivity and sound logic should be evidenced in the collection and analysis of the data.

(g) Conclusions and interpretations should be based on and warranted by the data presented.

For a more extensive guide to evaluation, reference may be made to Carmichael¹ or similar source.

5. Review articles shall be judged on the bases of current significance of the subject matter, comprehensiveness, and the quality of critical analysis and skill in integration shown by the author.

It may be suggested that review articles in significant areas be solicited and competent reviewers invited by the associate editors to write such articles.

IV. Specific Criteria for Evaluation with Respect to Form and Organization

1. Material shall be presented in a clear, logical, orderly, objective way. Chapter 20 of the Monograph on Research Methods may well serve as a guide.

2. Manuscripts submitted shall conform in technical details to the form prescribed by the editor. A description of technical details, i.e. bibliographical form, tables, illustrations, kind of paper, etc. shall be formulated by the editor, and given adequate publicity.

3. The material shall be presented in the briefest form consistent with clarity, accuracy and completeness. Standard statistical formulas need not be given nor commonly used techniques described in detail.

4. Correct use of language, as well as a certain dignity and objectivity in literary style, shall be expected.

Respectfully submitted,
Committee on Criteria for
Evaluation of Research Articles.
Karl Bookwalter
David K. Brace
H. D. Edgren
Esther French
Franklin Henry
Eleanor Metheny
Elizabeth Rodgers
Pauline Hodgson, Chairman

¹ Carmichael, L. Manual of Child Psychology. New York: J. Wiley and Sons, Inc., 1946.

Guide to Authors

In Line with the overall goal of making Association publications yield the greatest value to the individual and profession, the following is a yardstick for the preparation of research manuscripts. The information as spelled out below recognizes general techniques being employed by research publications of similar nature. Copy prepared on this basis looks forward to the establishment of a standard style for all Association research studies.

This "Guide to Authors" is a guide to consider. Your suggestions and comments will assuredly be appreciated.

Manuscripts

Manuscripts should be sent to the Editor who will see that each one is read by at least three members of the Board of Associate Editors. The Editor will advise the author as to the suitability of the paper or the desirability for revision. Papers are not judged by arbitrary standards of length but on their content of new research results in the field of physical education, health education, and recreation, presented with the greatest brevity compatible with scientific accuracy and clarity.

Since three members of the Board of Associate Editors review an article it is requested that three copies of the manuscript (the original and two clear carbons) be submitted in order to facilitate reviewing. One copy of the article should be retained by the author for checking against galley proofs. However, only one copy of any charts, photographs, drawings, graphs, or similar illustrative material need be submitted. They will be sent to each reviewer in turn.

Typewritten manuscript should be double spaced on white paper of ordinary weight and standard size ($8\frac{1}{2} \times 11$ inches).

The sheets of manuscript should be kept flat and fastened with clips which can be removed easily. The pages of the typewritten copy should be numbered consecutively in the upper right hand corner.

Paragraphs should be numbered consecutively throughout the manuscript, to facilitate ease of reference in case of revisions.

Documentation

Footnotes—Footnotes should be numbered from ¹ up for each article. The first footnote for each article should begin with ¹, a corresponding numeral appearing in the text. Footnotes should be separated from the text by lines across the bottom of the typewritten page. Sequence of information in a footnote is:

- (a) number,
- (b) author's first and last name,
- (c) article or chapter (if any) in quotes,
- (d) name of publication underscored,
- (e) city published (colon),
- (f) publisher,

(g) year,

(h) exact page reference.

In the event a bibliography is used at the end of an article, use above form except in (b) where author's last name comes first enabling an alphabetical listing. Where references are listed and cited at the conclusion of the article, do not duplicate information in footnotes.

Citation of Literature—Citations of literature should be segregated alphabetically by author's last name at the end of each article under the caption

of "References." Do not treat them as footnotes.

Literature citations should be numbered consecutively in the order of their appearance. Their location in the text should be indicated by full-sized figures enclosed in parentheses. For example, (1, 2, 3). Care should be exercised to segregate footnotes from literature citations.

A uniform style should be maintained in writing citations. Do not enclose titles of chapters and articles in quotation marks. Italicize [underscore] names

of books and publications. (See example below.)

A uniform sequence of data should be observed. The preferred sequence is: Author's name—title of article or chapter—name of book or publication—volume number—page numbers—year date.

EXAMPLE OF FOOTNOTE

³ H. Harrison Clarke. The Application of Measurement to Health and Physical Education. New York: Prentice-Hall, Inc., 1946. p. 240.

EXAMPLES OF REFERENCES APPEARING AT END OF ARTICLE

 DEAVER, G. G. Exercise and heart disease. Research Quarterly, 26:24-34 1939. (periodicals)

2. OGDEN, JEAN, AND JESS OGDEN. Small Communities in Action. New York,

City: Harper & Brothers, 1946. (books)

 POTTER, JOHN NICHOLAS. Physical Fitness of Junior High School Boys. Unpublished master's thesis, University of California. Berkeley, 1942. 39 pp.

Use of Numbers

Use figures for all definite weights, measurements, percentages, and degrees of temperature (for example: 2 kgm., 1 inch, 20.5 cc., 300°C.). Spell out all indefinite and approximate periods of time and other numerals which are used in a general sense (for example: one hundred years ago, about two-and-one-half hours, seven times). Spell out numbers through ten; Arabic figures for 11 and over.

Abbreviations

The metric system being in universal usage, standard abbreviations should be used whenever the weights and measurements are used with figures, i.e., 10 kgm., 6.25 cc., etc. The forms to be used are: cc., kgm., mgm., mm., l., and m. *Gram* should be spelled out in all cases to avoid possible confusion with

grain. All obscure and ambiguous abbreviations should be avoided. No abbreviations of English weights and measures should be used. Preserve uniformity in all abbreviations.

Tables

Each table should have a descriptive heading and should be specifically referred to in the text by number, e.g., "Table 10," etc., never as "the above table" or "the following table." Number tables from 1 up for the entire manuscript, using Arabic numerals. For graphic presentations, use Roman numerals. Per cent should be two words. Use per cent sign (%) in table or when it appears in parenthesis in text.

Never single space any tabular material.

Headings

Arrange article so as to indicate relative values of heading and subheadings. Usually four gradations are sufficient (a) article title, (b) first subhead appearing in boldface aligned left on page, (c) second subhead (if necessary) appearing in small caps aligned left on page, (d) third subhead, to appear in italic (underscored in manuscript), not centered, but run in at the beginning of the paragraph or section.

Illustrations

Illustrative material is of two types: pen and ink drawings, which are reproduced by the line engraving process; and photographs, wash drawings, stipple drawings, in short anything containing shading, which are reproduced by the halftone process.

Line engravings are always treated as text figures and should be so designated. All drawings should be made with India ink, preferably on white tracing paper or cloth. If co-ordinate paper is used, a blue-lined paper must be chosen, as all other colors blur on reproduction; sometimes it is desirable to ink in inch

squares so that the curves can be more easily read.

Lettering should be plain and large enough to reproduce well when the drawing is reduced to the dimensions of the printed page (4½ x 7 inches). Most figures can be advantageously drawn for a linear reduction of one-half or one-fourth. Co-ordinate lettering should be included within the chart. Do not use gummed letters, for they are easily lost.

Care should be taken not to waste space, as this means greater reduction and a less satisfactory illustration. Often it is possible to combine several curves in one figure and thus not only save space but enable the reader to make comparisons at a glance. Legends can often be included within the chart and a considerable saving in space thus effected.

Halftones are treated as plates and should be so designated. Frequently, several halftones can be grouped to form an attractive full page plate, in which case they should be numbered consecutively, in Arabic numerals, as figures of the plate. Photographs should be in the form of clear black and white prints

on glossy paper. Care should be taken to see that they cannot be bent or folded in handling and paper clips should not be used. All imperfections in the original

copy are reproduced.

Figures and plates should each be numbered consecutively from 1 up for the entire manuscript. Use Arabic numerals to number figures, and Roman numerals to number plates. The legends for the illustrations should be typed upon separate sheets and the sheets numbered at the end of the manuscript. Care should be taken to indicate plainly in the text the exact location of all illustrations and tables.

The Association will assume complete engraving expense.

Proofreading

Author will receive galley-proof.

Mark on proof the errors that are discrepancies in transcription from the manuscript in *red* ink. Mark any changes from copy in *black* ink. The two

classes of error are handled by two different operators.

Be sure to answer all queries on the proof. Write any instructions to the printer on the proof itself. (If instructions are written on separate sheets the parcel will require first class postage; if instructions are too extensive to write on proof, embody them in a letter and send separately.) Draw ring around instructions and answers to queries to avoid possibility of mistaking them for new copy. Return proof to the Editor.

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